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Sea Mines and Countermeasures: A Bibliography

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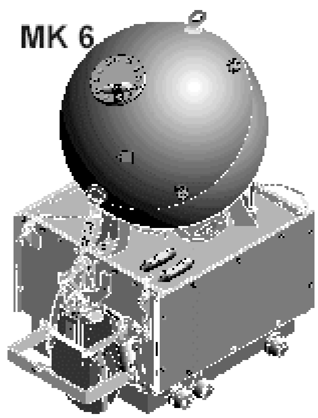

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Table of Contents

MINE DETECTION AND DETECTORS

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DOCUMENTS, THESES AND TECHNICAL REPORTS

Abelev, A. V., P. J. Valent and C. Barbu. **Risk Assessment and Implementation of Impact Burial Prediction Algorithms for Detection of Bottom Sea Mines.** Stennis Space Center, MS: Naval Research Laboratory, 2004. 16p.

ABSTRACT: This paper presents a probabilistic approach to predicting the risk of encountering mines impact buried in mud seafloors. This approach is based on a stochastic interpretation of the sets of both the input and the output parameters used by the existing predictive software. The input parameters describe the variability in the environmental parameters of the layered sediments, as well as the dynamic parameters of the mine impacting the mud line. The output parameters are represented by several variables most relevant to the Navy mine hunting forces, i.e. height proud or percentage of surface area proud. Both sets of input parameters are described using their Gaussian distributions, derived from experimental observations. The stochastic output of the predictive impact burial model is evaluated using a Monte-Carlo simulation technique and compared with the diver measured data. The model displays a somewhat better performance, in statistical terms, as opposed to the deterministic evaluations. Previously observed tendencies to overestimate the height protruding, the final pitch in mud and to underestimate the surface area exposed are confirmed but with the added information from comparing the probability distributions. The model evaluated produces a somewhat more meaningful result for the decision making process of the MCM forces if exercised in the suggested Monte Carlo framework. Reference probability charts are developed providing a more accurate and easier to interpret model output that could be effectively utilized by the Navy Mine Counter-Measures (MCM) forces.

ACCESSION NUMBER: ADA444543

http://handle.dtic.mil/100.2/ADA444543

Acquisition of the Airborne Laser Mine Detection System. Washington, DC. Department of Defense, Office of the Inspector General, 2 May 2001. 32p.

ABSTRACT: The Airborne Laser Mine Detection System is a mine countermeasure that is intended to detect, classify, and localize floating or moored sea mines that are near the surface. The Navy will deploy the Airborne Laser Mine Detection System on MH-60S helicopters to provide organic airborne mine defense for Carrier Battle Groups and Amphibious Ready Groups. The Navy will use this capability in littoral zones, confined straits, choke points, and the amphibious objective area. The system is portable and transferable and represents a capability that does not exist in the Navy's mine countermeasures inventory. The program office estimates that the system will cost $167.2 million for research, development, test and evaluation and $206.7 million for procurement. The Navy Acquisition Executive is the milestone decision authority for this Acquisition Category II program.

REPORT NUMBER: IG/DOD-D-2001-111
ACCESSION NUMBER: ADA389597

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Adkins, Arthur A. and David P. Burnette. **Solving the Mine Countermeasures Problem: A Matter of Focus and Priority**. Newport, RI: Naval War College, Center for Naval Warfare Studies, May 1996. 36p.

ABSTRACT: This document reviews mine countermeasure operations and how they impact on current national security and national military strategies as well as service doctrine. It recognizes *that shortfalls in dealing with sea mines still exist and recommends where resources should be focused in order tackle the most serious challenges facing future naval operations.*

REPORT NUMBER: NWC/CNWS-RR-1-96

ACCESSION NUMBER: ADA309750

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Ahn, So W. **Neutralization of Surf Region Mines**. Trident scholar project report. Annapolis, MD: Naval Academy, 9 May 1995. 124p.

ABSTRACT: There is significant military interest in the dynamic behavior of a net array of circular cylinders traveling through a fluid medium. Although research has been conducted on a towed single line configuration in water, there is little information regarding the dynamic behavior of a towed net configuration. This investigation examined the effect that physical geometry, tow velocity, and tow angle- of-attack had on the lift and drag acting on a net towed in water. The measurements indicate a significant relationship between these factors and the stability of the net, and also provide normalized polynomial equations which will be useful in predicting the aero-ballistics of the net.

ACCESSION NUMBER: ADA299408

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Akyol, Kadir. **Hardware Integration of the Small Autonomous Underwater Vehicle Navigation System (SANS) Using a PC/104 Computer**. Monterey, CA: Naval Postgraduate School, March 1999. 165p.

ABSTRACT: At the Naval Postgraduate School (NPS), a small AUV navigation system (SANS) has been developed for research in support of shallow-water mine countermeasures and coastal environmental monitoring. The objective of this thesis is to develop a new version of SANS, aimed at reducing size and increasing reliability by utilizing state-of-the-art hardware components. The new hardware configuration uses a PC/104 computer system, and a Crossbow DMU-VG Six-Axis Inertial Measurement Unit (IMU). The PC/104 computer provides more computing power and more importantly, increases the reliability and compatibility of the system. Replacing the old IMU with a Crossbow IMU' eliminates the need for an analog-to-digital (A/D) converter, and thus reduces the overall size of the SANS. The new hardware components are integrated into a working system. A software interface is developed for each component. An asynchronous Kalman filter is implemented in the current SANS system as a navigation filter. Bench testing is conducted and indicates that the system works properly. The new components reduce the size of the system by 52% and increase the sampling rate to more than 80Hz.

ACCESSION NUMBER: ADA362203

http://handle.dtic.mil/100.2/ADA362203

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Alexander, Lee, et al. **Q-Route Survey Demonstration Project Operational Assessment**. Final report. Groton, CT: Coast Guard Research and Development Center, June 1990. 119p.

ABSTRACT: The Q-Route survey mission involves exploratory ocean floor reconnaissance and the location/relocation of mine-like objects along established routes from the entrance of major U.S. ports to the continental shelf. This report presents results of a joint U.S. Coast Guard - U.S. Navy Q-Route Survey project conducted in New London, CT. USCG vessels were equipped with commercially-available equipment and systems, and manned by a mix of USCG and USN personnel. Results of at-sea operational evaluations intended to measure the effectiveness of an integrated navigation/data management system in meeting Q-route survey mission requirements are discussed. An integrated system configuration comprised of side scan sonar, display/data management, and navigation/positioning subsystem was found to be highly effective for *conducting detailed Q-route surveys. USCG vessels are suitable platforms from which to conduct coastal Q-route survey operations. No significant vessel-related constraints were associated with available working space, minimum vessel speed, or electrical power. A joint-service approach to Q-route survey operations effectively uses existing skills and talent. With only minimum training assigned USN personnel operated the equipment consoles while USCG personnel piloted the vessel and deployed/recovered the side scan sonar and acoustic tracker hydrophone. The most critical factor impacting the effective conduct of route survey operations was the availability and performance of the radio navigation system. During these trials Differential Loran-C provided a predictable, geodetic accuracy of 23 meters, 2 DRMS.*

ACCESSION NUMBER: ADA230638

http://handle.dtic.mil/100.2/ADA230638

Allen, Charles R. **Mine Drop Experiment II With Operational Mine Shapes (MIDEX II).** Monterey, CA: Naval Postgraduate School, 2006. 306p.

ABSTRACT: The Navy's Impact Burial Model (IMPACT35) predicts the cylindrical mine trajectory in air and water columns and burial depth and orientation in sediment. Impact burial calculations are derived primarily from the sediment characteristics and from the mine's three-dimensional air and water phase trajectories. Accurate burial prediction requires that the model's water phase trajectory reasonably mimics the object's true trajectory. In order to determine what effect varying the shape to more closely match real-world mines has on the shape's water phase trajectory, Mine Drop Experiment II was conducted. The experiment consisted of dropping four separate types of scaled shapes (Sphere, Gumdrop, Manta, and Rockan) into a water column, and the resultant falls were filmed from two nearly orthogonal angles. Initial drop position, initial velocities, and the drop angle were controlled parameters. The Sphere and Gumdrop shapes tended to have smooth arcing drop paths. The Manta shape dropped much more slowly than the Sphere or Gumdrop shapes. The Manta had a tendency to either fall in a spiral with its bottom parallel to the bottom or on its side in a twisting motion. The Rockan tended to either flip or swoop as it entered the water but then settle in a slow spin with its primary length parallel to the bottom. The dispersion of all four shapes at the selected depth of 2.5 m was wide and variable. The data collected from the experiment can be used to develop and validate the mine Impact Burial Prediction Model with operational, non-cylindrical mine shapes.

ACCESSION NUMBER: ADA445278

http://handle.dtic.mil/100.2/ADA445278

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Allen, Timothy E. **Using Discrete Event Simulation to Assess Obstacle Location Accuracy in the REMUS Unmanned Underwater Vehicle**. Master's thesis. Monterey, CA: Naval Postgraduate School, 2004. 149p.

ABSTRACT: Navy personnel use the REMUS unmanned underwater vehicle to search for submerged objects. Navigation inaccuracies lead to errors in predicting the location of objects and thus result in increased search times for Explosive Ordnance Disposal (EOD) teams searching for the object post-mission. This thesis explores contributions to navigation inaccuracy using Discrete Event Simulation (DES) to model the vehicle's navigation system and operational performance. The DES produced for this thesis uses the JAVA-based Simkit package to simulate the navigation system in REMUS. The model considers factors affecting accuracy, such as compass error, the effect of current, transducer drop error, transducer positioning effects, and ping interval. Mines can be placed at specific locations or generated randomly. Three types of vehicles are considered in this thesis. First, a simple vehicle that navigates by Dead Reckoning is analyzed. Second, a more complex vehicle that navigates using Long-Baseline (LBL) is analyzed. Third, the vehicle is simulated to move through an area of interest in a sweeping pattern that is populated by 10 mines, each of which is randomly positioned. Data from the last vehicle are used to build three analytic models that the operator can use to improve performance. First, the probability of detection is modeled by a logit regression. Second, given that detection has *occurred, the mean location offset is modeled by a linear regression. Third, the distribution of errors is shown to follow an exponential distribution. These three models enable operators to explore the impact of various inputs prior to programming the vehicle, thus allowing them to choose the best combination of vehicle parameters that minimize the offset error between the reported and actual locations.*

ACCESSION NUMBER: ADA424759

http://handle.dtic.mil/100.2/ADA424759

http://edocs.nps.edu/npspubs/scholarly/theses/2004/Jun/04Jun_Allen.pdf

Altenburg, Robert .A., Karl W. Rehnn, and Nicholas P. Chotiros. **Sediment Classification and Bathymetry Data Acquired from the AN/UQN-4 Depth Sounder in Support of MTEDS**. Austin, TX: University of Texas, Austin, Applied Research Laboratories, 25 October 1995. 55p.

ABSTRACT: A realtime system for the measurement of the bottom reflection coefficient using the AN/UQN-4 depth sounder was developed. Data provided by the system is transferred to the MTEDS database system where it is made available to the Acoustic Sediment Classification System (ASCS). In addition to the bottom reflection coefficient, the system also provides time and ship's position from a built-in GPS receiver, and depth data for the MTEDS database. Three sea tests provided data for system development. In addition, geophysical measurements, which were made during the sea tests by the Coastal Benthic Boundary Layer Special Research Project, were used to verify the system results. Basic design features of the system, both hardware and software, are discussed.

REPORT NUMBER: ARL-TR-95-31

ACCESSION NUMBER: ADA308224

http://handle.dtic.mil/100.2/ADA308224

An, M., JT Cobb, B. Shenefelt, and R Tolimieri. **Advances in Group Filter Applications to Sea Mine Detection**. Panama City Beach, FL: Prometheus Inc., 2006. 6p.

ABSTRACT: Automatic detection of sea mines in coastal regions is a difficult task due to the highly variable sea bottom conditions present in the underwater environment. Detection systems must be able to discriminate objects which vary in size, shape, and orientation from naturally occurring and man-made clutter. Additionally, these automated systems must be computationally efficient to be incorporated into unmanned underwater vehicle (UUV) sensor systems characterized by high sensor data rates and limited processing abilities. Using noncommutative group harmonic analysis, a fast, robust sea mine detection system is created. A family of unitary image transforms associated to noncommutative groups is generated and applied to side scan sonar image files supplied by Naval Surface Warfare Center Panama City (NSWC PC). These transforms project key image features, geometrically defined structures with orientations, and localized spectral information into distinct orthogonal components or feature subspaces of the image. The performance of the detection system is compared against the performance of an independent detection system in terms of probability of detection (Pd) and probability of false alarm (Pfa).

ACCESSION NUMBER: ADA499223

http://handle.dtic.mil/100.2/ADA499223

Anderson, Lloyd D. **Vector Acoustic Mine Mechanism**. Patent. Washington, DC: Department of the Navy, February 1980. 11p.

ABSTRACT: This patent discloses a submarine mine actuating system responsive to the acoustic pressure signature of a target vessel moving through the water in the vicinity of the system comprising; an array of hydrophones including a first velocity hydrophone having a cosine *response pattern and generating an electric signal in response to received underwater acoustic signals originating from said target vessel, and second velocity hydrophone having a response pattern similar to that of said first hydrophone and disposed in orthogonal relation therewith whereby the axes of maximum sensitivity of said hydrophones are mutually perpendicular so that the signals produced by said hydrophones undergo a phase reversal as the target vessel crosses an axis of maximum sensitivity of one of said hydrophones; a pair of transformers each having a primary coil coupled to the output of a respective one of said hydrophones to receive an output signal therefrom, a ring demodulator circuit having a first and a second pair of input terminals each connected across the respective secondaries of said transformers, a center-tap at each secondary winding of said demodulator circuit correlative to the phase relationship of the signals applied across the input terminals of said circuit to thereby indicate a phase reversal of the received acoustic signal as the target vessel crosses the axis of one of said hydrophones of said array.*

REPORT NUMBER: PATENT: 4,189,999

http://www.uspto.gov/patft/

Anglin, Anthony J. **Investigation of Surface Waves Using a Two-Axis Source-Receiver Combination**. Monterey, CA: Naval Postgraduate School, June 1996. 76p.

ABSTRACT: The goals of this thesis are (1) to design and test a two-axis surface wave source and two-axis surface wave receiver and (2) to investigate the use of surface waves to detect buried objects in water saturated sand. Results of measurements confirm the ability to generate particle motions in water saturated sand consistent with surface wave excitation. However, limitations in the size of the test tank prohibit a thorough investigation of the ability of the source and receiver to selectively excite and detect surface waves.

ACCESSION NUMBER: ADA314966

http://handle.dtic.mil/100.2/ADA314966

APL-UW High-Frequency Ocean Environmental Acoustics Models Handbook. Seattle, WA: Applied Physics Laboratory, October 1994. 210p.

ABSTRACT: This report updates several high-frequency acoustic models used in simulations and system design by Navy torpedo and mine countermeasure programs. The models presented augment and supersede those given previously in APL-UW technical note 7-79 (August 1979) and its successors, APL-UW technical reports 8407 and 8907. The report addresses the interaction of high-frequency acoustic energy with the ocean's volume, surface, bottom, and ice. It also addresses ambient noise generated by physical processes at the ocean surface and by biological organisms. The results are given in a form that can be exploited in simulations. The relevant fundamental experimental and theoretical research by APL and others upon which these models are based is available in the references.

REPORT NUMBER: APL-UW-TR-9407

ACCESSION NUMBER: ADB199453

http://handle.dtic.mil/100.2/ADB199453

Arslan, Suat. **Testing and Evaluation of the Small Autonomous Underwater Vehicle Navigation System (SANS).** Monterey, CA: Naval Postgraduate School, March 2000. 108p.

ABSTRACT: At the Naval Postgraduate School (NPS), a small AUV navigation system (SANS) was developed for research in support of shallow-water mine countermeasures and coastal environmental monitoring The objective of this thesis is to test and evaluate the SANS performance after tuning the filter gains through a series of testing procedures. The new version of SANS (SANS III) used new hardware components which were smaller, cheaper, and more reliable. A PC/l O4 computer provided more computing power and, increased the reliability and *compatibility of the system. Implementing an asynchronous Kalman filter in the position and velocity estimation part of the navigation subsystem improved the navigation accuracy significantly. To determine and evaluate the overall system performance, ground vehicle testing was conducted. Test results showed that the SANS III was able to navigate within + 15 feet of Global Positioning track with no Global Positioning update for three minutes.*

ACCESSION NUMBER: ADA376607

http://handle.dtic.mil/100.2/ADA376607

http://edocs.nps.edu/npspubs/scholarly/theses/00Mar_Arslan.pdf

Avera, William E., et al. **Multibeam Bathymetry from a Mine-Hunting Military Sonar**. Stennis Space Center, MS: Naval Research Center, 11 June 2002. 17p.

*ABSTRACT: Multibeam bathymetry is obtained from the AN/AQS-20 **mine**-hunting sonar system. The AN/AQS-20 Volume Search Sonar uses a swath of beams directed downward and perpendicular to the direction of motion to cover more than 180 degrees around the sensor. This coverage creates a coarse-sampling, multibeam sonar that can measure the bottom depth. Raw beamformed data are available from a dedicated experiment to demonstrate the feasibility for using this system to update existing bathymetric databases during mine hunting operations. Data processing uses a weighted-mean-time technique to determine the bottom reflection return from the downward directed beams within +45 degrees of the nadir beam (producing 90 degree swath). Data are compared with a recent multibeam survey covering the same location to determine the accuracy and optimize the data processing. The recent multibeam survey was obtained as a ground truth' using a conventional EM-1002 multibeam system. Comparison of the AN/AQS-20 data with the ground truth demonstrated good agreement for bathymetry and is within the requirements for mine warfare operations. Limitations on the bathymetry accuracy are related to the pressure sensor that measures tow-body depth.*

ACCESSION NUMBER: ADA406721

http://handle.dtic.mil/100.2/ADA406721

Ayers, Joseph, et al. **Biometric Robots for Shallow Water Mine Countermeasures**. Boston, MA: Northeastern University, Marine Science Center, 2000? 16p.

ABSTRACT: We are developing two classes of biomimetic autonomous underwater vehicles based on animal models with superior performance in shallow water. The first is an 8-legged ambulatory vehicle, that is based on the lobster and is intended for autonomous mine countermeasure operations in rivers, harbors and/or the littoral zone ocean bottom with robust adaptations to irregular bottom contours, current and surge. The second vehicle is an undulatory system that is based on the lamprey and is intended for remote sensing operations in the water column with robust depth/altitude control and high maneuverability. These vehicles are based on a common biomimetic control, actuator and sensor architecture that features highly modularized components and low cost per vehicle. Operating in concert, they can conduct autonomous investigation of both the bottom and water column of the littoral zone or rivers. These biomimetic systems represent a new class of autonomous underwater vehicles that may be adapted to operations in a variety of habitats.

http://www.neurotechnology.neu.edu/NPS2000Manuscript.pdf

Barrett, R. E., G. W. Landwehr, and J. K. Major**. Mine Detection and Location with Type 1174 Sonar**. New Haven, CT: Yale University, Laboratory of Marine Physics, March 1954.

ABSTRACT: None Available.

ACCESSION NUMBER: AD030022

http://handle.dtic.mil/100.2/AD030022

Bauer, Eric J. **Fuzzy Auto Detection of Bottom Mines**. Master's thesis. Boca Raton, FL: Florida Atlantic University, 2000. 115p.

Abstract: An automatic mine detection method has been designed for the purpose of locating mine-like objects on the seabed in real time using a high frequency, high resolution side scan sonar. The processing flow includes a calculation of the average scattering function of the local environment, shadow detection, and a fuzzy logic clustering/fuzzy logic detection procedure for identifying mine-like shadows. An Autonomous Underwater Vehicle (AUV) equipped with a fuzzy detection system gives the Navy the capability of rapidly locating bottom mines in littoral underwater environments during over-the-horizon operations.

Blair, David G. **Array Design: Literature Survey for A High-Resolution Imaging Sonar System. Pt 1**. Technical note. Ascot Vale (Australia): Materials Research Laboratories, December 1993. 37p.

ABSTRACT: This report, together with the proposed Part 2, surveys the literature relevant to the design of a sonar array for imaging mines with a resolution approaching 1 mm. Written as a descriptive and sometimes critical review, the report draws out the connections to mine imaging. Background areas surveyed include acoustic propagation and scattering, signal processing and display. The theory of array beamforming is traced, beginning from basics and including the near field and broadband signals. Three-dimensional beamforming, by the delay-and-add method and by backpropagation (numerical holography), are discussed. Working systems and related development work are described, including sonar systems, high-resolution underwater imaging, imaging in medicine and nondestructive evaluation, synthetic aperture, acoustic holography and tomography.

ACCESSION NUMBER: ADA277070

http://handle.dtic.mil/100.2/ADA277070

Blankenship, James R. **Assessing the Ability of Hyperspectral Data to Detect Lyngbya SPP: A Potential Biological Indicator for Presence of Metal Objects in the Littoral Environment**. Monterey, CA: Naval Postgraduate School, 2006. 241p.

ABSTRACT: The aquatic filamentous bacteria (Cyanobacterium) Lyngbya majuscula is a nitrogen-fixer found in coastal waters often attached or adjacent to sea grass, algae and coral. It is characterized by phycobiliproteins, unique pigments found only in cyanobacteria. To sustain photosynthesis and nitrogen fixation, L. majuscula requires iron proteins and is therefore sensitive to the availability of this metal. The hypothesis tested in this study concerns the potential use of hyperspectral imaging in detecting L. majuscula in coastal regions as biological indicators for the presence of iron debris or metal objects in the littoral environment. This concept would have potential benefits and applications in mine detection and countermeasure techniques. Using a USB2000 field spectroradiometer, a spectral library was developed for the benthic substrates of Midway Atoll, Northwest Hawaiian Islands, spectrally characterizing L. majuscula and the surrounding coral reef substrates. The data was analyzed to determine unique spectral characteristics of the benthic cyanobacteria in a mixed coral environment and evaluated against the resampled spectral resolution of a number of hyperspectral sensors: Airborne Visible/Infrared Imaging Spectrometer (AVIRIS), Hyperspectral Mapper (HyMap) and Compact Airborne Spectrographic Imager (CASI). The results of the in situ spectroscopy suggest a strong potential for all three sensors to detect these cyanobacteria in a mixed coral reef environment at four distinct wavelengths attributable to phycobiliprotein pigment absorptions unique to cyanobacteria. Of these four discriminative absorption ranges, the phycoerythrin absorption of 565-576 nm shows the greatest potential for segregating cyanobacteria from a mixed algal/ coral / sand environment so long as the coral Montipora spp. is not present within the scene, since it has an overlapping absorption in those wavelengths. In the presence of Montipora corals, these cyanobacteria are more difficult to detect. However, in a mixed environment composed of L.

majuscula and Montipora corals, the cyanobacteria can be distinguished by a different phycocyanin absorption, at 615-632 nm.
ACCESSION NUMBER: ADA460474
http://handle.dtic.mil/100.2/ADA460474
http://edocs.nps.edu/npspubs/scholarly/theses/2006/Dec/06Dec_Blankenship.pdf

Blumenberg, Michael A. **Analysis of Explosive Ordnance Disposal Support Facilities Aboard the AVENGER (MCM-1) Class Ships**. Washington, DC: Naval Sea Systems Command, December 1991. 96p.
ABSTRACT: The United States Navy's AVENGER Class mine countermeasures ships are designed with facilities to support an explosive ordnance disposal detachment. However, the design and use of these facilities has not been endorsed by either the United States Navy's explosive ordnance disposal community, mine warfare community or crews of the AVENGER Class ships. This research paper investigates the above circumstances by discussing the missions and capabilities of an explosive ordnance disposal detachment and the MCM-1 Class ships in mine countermeasures operations. This study will conclude by recommending a definitive relationship between explosive ordnance disposal detachments and the AVENGER Class ships for mine countermeasures operations, including recommendations for actions necessary to achieve this relationship.
ACCESSION NUMBER: ADA331928
http://handle.dtic.mil/100.2/ADA331928

Boerman, Douglas A. **Finding an Optimal Path Through a Mapped Minefield**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1994. 55p.
ABSTRACT: An integer programming model is developed to find an optimal path through a naval minefield which has been completely mapped. The region of the minefield is discretized into a grid network and a network flow model with side constraints is created to minimize the sum of a weighted combination of risk and distance along any path through the minefield. Tests are conducted on a 20x20 grid with a field of 10 mines. This generates a model with 1470 variables and 818 constraints which is solved on an 80386 33 MHZ PC in 405 seconds. Tests are run for various weights and to test the effects of shifting the grid in space. Results show that varying the weight yields paths with sensible tradeoffs between distance and risk, and show that improved paths can be obtained by shifting the network grid. The model developed provides users with a means to plan a covert penetration of a minefield using the potential intelligence gathering capabilities of an autonomous underwater vehicle.

Borden, Steven A. **Mine Countermeasures: A Comparative Analysis of US Navy Mine Countermeasures 1999 vs. 2020**. Carlisle Barracks, PA: Army War College, 10 April 2000. 41p.
ABSTRACT: The intent of this project is to complete a comparative analysis of current US Navy Mine Countermeasures capabilities versus projected capabilities in 2020. Following a historical background, this paper will review the current force structure, its capabilities and how this force operates. It will describe proposed changes to the force and alternative concepts of operation for the 2020 timeframe. Additionally, it will relate the impact of future mine countermeasures capabilities to the ability of naval forces to conduct operational maneuver from the sea and the impact to strategic sealift timelines.
ACCESSION NUMBER: ADA377403
http://handle.dtic.mil/100.2/ADA377403

Bower, Grant R, et al. **Indian Rocks Beach Experiment**, **January-March 2003.** Stennis Space Center, MS: Naval Research Laboratory, 2004. 103p.
ABSTRACT: An experiment to characterize subsequent (scour) mine burial was conducted in the winter of 2003 in water depth of 13 meters near Tampa Bay, Florida. Four NRL Acoustic Instrument Mines (AIMs), Six Forschungsanstalt der Bundeswehr fur Wasserschall- und Geophysik (FWG) Instrumented Mines and two each Inert Manta Mines, Rockan Mines and 500 lb bombs were placed on the seafloor and left for a period of approximately 64 days. The instrumented mines will provide temporal burial status the burial status of the inert assemblies was observed and noted by divers. This preliminary report includes the diver observed data upon recovery for each mine, the recorded orientation change for each FWG mine and for each AIM the recorded burial, orientation, water temperature, tide wave period and significant weight height.
ACCESSION NUMBER: ADA422065
http://handle.dtic.mil/100.2/ADA422065

Bradley, Stephen C. **Clearing the Vital Choke Points in the Sea Lines of Communication - Its Not Just a Navy Problem and Solution**. Final report. Newport, RI: Naval War College, Department of Operations, 17 May 1993. 32p.
ABSTRACT: This paper is primarily a thought process. Many scholarly works and group efforts have pointed clearly to the abysmal condition of the United States Naval Mine Countermeasures (MCM) both in capability and size. The problems which the U S Navy has in this capability stem from two reasons: first, an historic lack of effort in funding a robust MCM capability, and second, there are limitations in the laws of physics which make detection of mines a difficult process. The purpose of this paper is not to split the arrow which has already landed in the center of the Navy's MCM forces, but to stimulate the reader to not view MCM as the Navy problem. There are no quick solutions to the problems. However, the operational commander who reviews the entire process of mine warfare and its countermeasures has a better chance of employing and assisting a Naval force in dealing with this threat. There are two purposes to this paper-first is to show that MCM operations are not just minesweeping/minehunting; second is to suggest that Army, Air Force, and Marine forces may be very useful in keeping the vital choke points in the Sea Lines Of Communication (SLOC) open against Naval mines.
ACCESSION NUMBER: ADA266702
http://handle.dtic.mil/100.2/ADA266702

Brandes, Horst G and H. R. Riggs. **Modeling of Sediment Mechanics for Mine Burial Prediction.** Honolulu, HI: University of Hawaii, 2004. 11p.
ABSTRACT: Numerical model development and testing were carried out for the purpose of assessing the influence of seafloor liquefaction on the burial of mines in shallow water due to cyclic loading by surface water waves. This project was conducted as part of the Office of Naval Research Mine Burial Prediction program (Code 321).
ACCESSION NUMBER: ADA429111
http://handle.dtic.mil/100.2/ADA429111

Briggs, Kevin B. **High-Frequency Acoustic Scattering from Sediment Interface Roughness and Volume Inhomogeneities**. Final report. Stennis Space Center, MS: Naval Research Laboratory Detachment, 5 December 1994. 156p.
ABSTRACT: High-frequency acoustic and geoacoustic data from five experiment sites with different sediment types are compared with predictions from the composite roughness model to ascertain the relative contribution of interface roughness and sediment volume scattering. Model fits to backscattering data from silty sediments indicate that volume scattering predominates, but measured bottom roughness was sufficient to explain the backscattering measured from a

rippled, sandy sediment. Fluctuations in sediment porosity and sound velocity probably cause volume scattering, which is described by a free parameter in the composite roughness model comparisons. High-resolution vertical profiles of sediment porosity and compressional wave velocity collected from 14 diverse sites on continental shelves are used to calculate vertical spatial autocorrelation functions, variance of the fluctuations, and the dependence of sediment sound velocity and density on sediment porosity for parameterizing sediment volume inhomogeneity. Correlation lengths calculated from autocorrelation functions show maximum variability in poorly sorted sediments. The variance of porosity and velocity fluctuations, which determines the strength of volume scattering, exhibits wide variation with sediment type and depends on the processes that mix and transport sediments. Comparison of data from a large number of locations on continental shelves suggests that fluctuations in sediment porosity are due to biological and sedimentological processes and that fluctuations in sediment velocity are due to hydrodynamic processes.

ACCESSION NUMBER: ADA291610
http://handle.dtic.mil/100.2/ADA291610

Brunk, D. H. **Data Processing Programs for Mine Countermeasures Navigation in Operation END SWEEP**. Panama City, FL: Naval Coastal Systems Laboratory, July 1973. 45p.
ABSTRACT: Operation END SWEEP was undertaken to clear mines from the harbor at Haiphong, North Vietnam. The Raydist T hyperbolic radio navigation system was used to provide precise navigation for the mine countermeasures helicopters. Automatic data processing with WANG equipment was used to establish the navigation reference stations, to plot navigation charts and important positions, and to determine navigational accuracy. A library of 10 programs was prepared by the Naval Coastal Systems Laboratory and used in the operational area by Task Force 78. Each program and instructions for its use are described in the report, while program machine code listings are contained in the supplement. The data processing equipment and programs performed very satisfactorily.
REPORT NUMBER: NCSL-169-73
ACCESSION NUMBER: AD0912485

Brunk, D.H. **Data Processing Programs for Mine Countermeasures Navigation in Operation END SWEEP. Calculator Program Details. Supplement I**. Panama City, FL: Naval Coastal Systems Laboratory, July 1973. 134p.
ABSTRACT: This supplement contains details of the WANG 720C Calculator programs developed to provide navigation data processing for Operation END SWEEP.
REPORT NUMBER: NCSL-169-73-SUPPL-1
ACCESSION NUMBER: AD0912486

Bucaro, Joseph A., et al. **Wide Area Detection and Identification of Underwater UXO Using Structural Acoustic Senors: 4th Annual Report to SERDP MM-1513**. Washington, DC: Naval Research Laboratory, Acoustics Division, 2010. 43p.
ABSTRACT: This project is exploring the development of a structural acoustics (SA) based sonar methodology for wide area search and identification of underwater unexploded ordnance (UXO). This approach has significant advantages over conventional acoustic approaches relying on formation of high resolution images including: diverse set of fingerprints leading to low false alarm rates; longer range leading to wide area coverage; and low frequency sediment penetration leading to buried target prosecution. A core element of the project is an examination of the scattering features exhibited by typical UXO targets in the SA regime using NRL's state-of-the-art

underwater scattering facilities, both laboratory-based and at-sea. We have extended the original mono-static data base to include bi-static data from proud and partially buried targets, examined the special case of forward scattering and how it might be exploited, connected laboratory UXO scattering measurements to those made in St. Andrew's Bay by employing an advanced acoustic multi-path propagation model, and examined the scattering from proud and buried targets on smooth and rough sediment surfaces using an elasto-dynamic finite integration technique (EFIT) numerical simulation model.

ACCESSION NUMBER: ADA525163

http://handle.dtic.mil/100.2/ADA525163

Campbell, Michael S. **Real-Time Sonar Classification for Autonomous Underwater Vehicles**. Monterey, CA: Naval Postgraduate School, March 1996. 119p.

ABSTRACT: The Naval Postgraduate School autonomous underwater vehicle (AUV) Phoenix did not have any sonar classification capabilities and only a basic collision avoidance system. The Phoenix also did not have the capability of dynamically representing its environment for path planning purposes. This thesis creates a sonar module that handles real time object classification and enables collision avoidance at the Tactical level. The sonar module developed communicates directly with the available sonar and preprocesses raw data to a range-bearing data pair. The module then processes the range-bearing data using parametric regression to form line segments. A polyhedron building algorithm combines line segments to form objects and classifies them based on their attributes.

ACCESSION NUMBER: ADA308081

http://handle.dtic.mil/100.2/ADA308081

http://edocs.nps.edu/npspubs/scholarly/theses/96Mar_Campbell.pdf

Carter, G. C. **Submarine Sonar System Concepts for Littoral Waters (Preliminary Unabridged Version)**. Final report. Newport, RI: Naval Undersea Warfare Center Division, January 1996. 17p.

ABSTRACT: This document contains the unabridged (original) manuscript submitted to the Naval Submarine League for publication in The Submarine Review.

ACCESSION NUMBER: ADA304412

http://handle.dtic.mil/100.2/ADA304412

Cashman, T.M. **Striking First...Mine Warfare Goes on the Offensive**. Newport, RI: Naval War College, Joint Military Operations Department, 13 May 2002. 18p.

ABSTRACT: The indiscriminate laying of sea mines in international waters is an act of war waged by terrorist groups and non-state actors. If the United States is going to successfully counter this act of overt aggression and be successful in future conflicts which involve the illegal use of mines, it must deter the belligerent through political, diplomatic, and if necessary, physical force. History is replete with examples of the effective use of sea mines to deter, alter or counter enemy forces. In today's environment, mines have been used more as an act of terror than a legal weapon of war. Historically, the U.S. Navy has shown a reluctance to adequately fund and appreciate the value of an aggressive countermine force. As a result, U.S. and coalition forces have been needlessly subjected to higher risks, delayed or altered battle plans and operationally limited in their course of action. Once mines are placed in the water the belligerents have gained the strategic, operational and tactical upper hand. From a time, space and force standpoint, the combination of U.S. mine countermeasures and allied forces is marginally sufficient to counter this threat and enable the naval commander the ability to effectively 'control the sea.' This should be the siren call to all naval commanders. Unless the United States leads the way in treating the indiscriminate laying of mines in international waters as an act of war, the United States and its allies will not be able to project forces ashore or control the seas without encountering *considerable risks. The time is now to set the stage for new international laws regarding mine warfare, redefine rules of engagement, break down inter-service politics, educate the media, and build coalition support. The U.S. needs to muster the political will to strike first or suffer the consequences from a military and economic standpoint.*

ACCESSION NUMBER: ADA405922

http://handle.dtic.mil/100.2/ADA405922

Chang, Min F. and Charles M. Loeffler. **Additional Mine Classification Capabilities for the INSS**. Austin, TX: University of Texas, Applied Research Laboratories, 2003. 64p.

ABSTRACT: As a diver scans shallow water or very shallow water (SW/VSW) area with an INSS high frequency sonar, many objects may be detected or imaged in the scene. The objective of this project is to develop algorithms that capture the broadband echo responses from these objects detected by the INSS and extract special echo features to assist in target discrimination from the background. The algorithms are based upon geometric acoustics, broadband array and signal processing techniques, and the physics of elastic waves on thin shells. Initially, three algorithms were investigated for acoustic robustness. These were, Shell Thickness Resonance (STR) Frequency Notch to estimate the targets shell thickness, Local Target to Bottom Multi-path Echo to discriminate cylindrical and spherical objects, and Multi-channel Phase Comparison (MPC) to estimate the target's height. The third algorithm, MPC, was the most acoustically robust, but required a modification to the INSS array geometry. The first algorithm, STR, was sufficiently robust to be implemented within an INSS unit and tested with Navy and ARL:UT divers. The implementation required reductions in the algorithm's capabilities to fit within the INSS hardware and software architecture. Three sets of diver tests were conducted In Lake Travis Texas and Coronado California. The final recommendation was to not modify the current operational systems but to consider the STR and MPC algorithms as part of the target sensing and discrimination suites in future Implementations of broadband sonar systems.

ACCESSION NUMBER: ADA417359

http://handle.dtic.mil/100.2/ADA417359

Chotiros, Nicholas P. **Environmental Data from UUV Systems and Purple Star**. Austin, TX: University of Texas, Austin, Applied Research Laboratories, 17 June 1997. 25p.

ABSTRACT: This is a progress report for the first year of work on bottom classification using tactical sensors. Data from a TVSS experiment in 1994, at deep and shallow sites, were provided by CSS and distributed by NRL/SSC. The data were processed and analyzed to provide calibration in a self-consistent manner and then to compute the magnitude of the normal incidence bottom reflection coefficient, which was then used to estimate bottom type. Difficulties due to clipping of the signal were detected and partially overcome.

ACCESSION NUMBER: ADA327069

http://handle.dtic.mil/100.2/ADA327069

Chu, Peter C., et al. **Yellow Sea Mine Hunting Using the Navy's CASS/GRAB Model**. Monterey, CA: Naval Postgraduate School, May 2001. 284p.

ABSTRACT: The purpose of this work is to determine the necessity of a near real time ocean modeling capability such as the Naval Oceanographic Office's (NAVOCEANO) Modular Ocean Data Assimilation System (MODAS) model in shallow water (such as the Yellow Sea) mine hunting applications using the Navy's Comprehensive Acoustic Simulation System Gaussian Ray Bundle (CASS/GRAB) model. Sound speed profiles inputted into the CASS/GRAB were calculated from observational (MOODS) and climatological (GDEM) data sets for different seasons and regions of four different bottom types (sand, gravel, mud, and rock). The CASS/GRAB model outputs were compared to the outputs from corresponding MODAS data

sets. The results of the comparisons demonstrated in many cases a significant acoustic difference between the alternate profiles. These results demonstrated that there is a need for a predictive modeling capability such as MODAS to address the Mine Warfare (MIW) needs in the Yellow Sea region. There were some weaknesses detected in the profiles the MODAS model produces in the Yellow Sea, which must be resolved before it can reliably address the MIW needs in that region.

REPORT NUMBER: NPS-IJWA-01-016
ACCESSION NUMBER: ADA391852
http://handle.dtic.mil/100.2/ADA391852

Cintron, Carlos J. **Environmental Impact of Mine Hunting in the Yellow Sea Using the CASS/GRAB Model**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 2001. 284p.

ABSTRACT: The purpose of this work is to determine the necessity of a near real time ocean modeling capability such as the Naval Oceanographic Office's (NAVOCEANO) Modular Ocean Data Assimilation System (MODAS) model in shallow water (such as the Yellow Sea) mine hunting applications using the Navy's Comprehensive Acoustic Simulation System Gaussian Ray Bundle (CASS/GRAB) model. Sound speed profiles inputted into the CASS/GRAB were calculated from observational (MOODS) and climatological (GDEM) data sets for different seasons and regions of four different bottom types (sand, gravel, mud, and rock). The CASS/GRAB model outputs were compared to the outputs from corresponding MODAS data sets. The results of the comparisons demonstrated in many cases a significant acoustic difference between the alternate profiles. These results demonstrated that there is a need for a predictive modeling capability such as MODAS to address the Mine Warfare (MIW) needs in the Yellow Sea region. There were some weaknesses detected in the profiles the MODAS model produces in the Yellow Sea, which must be resolved before it can reliably address the MIW needs in that region.

ACCESSION NUMBER: ADA390451
http://handle.dtic.mil/100.2/ADA390451

Coke, Hartwell F. V. **Route Survey Periodicity for Mine Warfare**. Monterey, CA: Naval Postgraduate School, 2009. 73p.

ABSTRACT: One of the Navy's most long standing challenges has been conquering the mine warfare threat. As mines and mine warfare techniques evolve and become more sophisticated, so does the United States' ability to counter the threat. The United States newest technique for countering a potential mined harbor, or route, is a process known as change detection. This concept uses previous side scan sonar images of the area prior to a mining event and compares those images to a recent scan post the mining event. This allows trained technicians to identify and classify previously recognized Non-Mine, Mine-Like Bottom Objects (NOMBOs) from new shapes present on the seafloor. The object of this classification is to reduce the number of hours searching and clearing previously existing objects that are thought to be mines. If the object or shape was present before the mining event, then it can be neglected from further inspection. The challenge is having a sufficiently current scan of the area on the shelf. The environmental bottom conditions of certain locations change dramatically more often than others. It is necessary to update more frequently scans of bottom regions that present large change rates than of areas that have smaller change rates. This thesis will present a logical effort, based on known bottom conditions, to aid in determining the rate, or periodicity, at which certain regions should be surveyed in order to have a quality scan standing by. The Resurvey Integration Model (RIM) will provide a user friendly method to efficiently and effectively predict a reasonable periodicity interval of an area to support the Navy's Mine Warfare and Meteorology and Oceanography communities. Use of this model will stand to reduce unnecessary expenditure of assets, resources and time on areas that do not require as frequent of surveys. These up to date scans will in turn aid in expediting the clearing of routes, ports and harbors after a mining event.

ACCESSION NUMBER: ADA508959
http://handle.dtic.mil/100.2/ADA508959
http://edocs.nps.edu/npspubs/scholarly/theses/2009/Sep/09Sep_Coke.pdf

Compton, Mark A. **Minefield Search and Object Recognition for Autonomous Underwater Vehicles**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1992. 257p.
ABSTRACT: Autonomous Underwater Vehicles (AUV) are an outstanding minefield search platform. Because of their stealthy nature, AUVs can be deployed in a potential minefield without the enemy's knowledge. They also minimize dangerous exposure to manned and more expensive naval assets. This thesis explores two important and related aspects of AUV minefield search: exhaustive sensor coverage of a minefield through effective path planning and underwater object recognition using the vehicle's sensors. The minefield search algorithm does not require a priori knowledge of the world except for user-defined boundaries. It is a three-dimensional, prioritized graph search using a ladder based methodology and an A optimal path planning algorithm. The minefield search algorithm effectively ignores areas which are blocked by obstacles, performs terrain following and avoids local minima problems encountered by other area search solutions. The algorithm is shown to be effective using a variety of graphical simulators. The object recognition algorithm provides autonomous classification of underwater objects. It uses geometric reasoning and line fitting of raw sonar data to form geometric primitives. These primitives are analyzed by a CLIPS language expert system using heuristic based rules. The resulting classifications may be used for higher level mission planning modules for effectively conducting the minefield search. Actual NPS AUV swimming pool test runs and graphic simulations are used to demonstrate this algorithm which was built in cooperation with Lieutenant Commander Donald P. Brutzman, USN.*
ACCESSION NUMBER: ADA250093
http://handle.dtic.mil/100.2/ADA250093

Cornelius, Michael. **Effects of a Suspended Sediment Layer on Acoustic Imagery**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 2004. 64p.
ABSTRACT: The Navy's CASS/GRAB sonar model is used to accurately simulate a side-scan sonar image with a mine-like object present through its reverberation characteristics. The acoustic impact of a suspended sediment layer is investigated numerically using CASS/GRAB through changing the volume scattering characteristics of the lower water column. A range of critical values of volume scattering strength were discovered through repeated model simulations. An understanding of the acoustic characteristics of suspended sediment layers can aid the Navy in the detection of mines that might exist within these layers.
ACCESSION NUMBER: ADA424675
http://handle.dtic.mil/100.2/ADA424675
http://edocs.nps.edu/npspubs/scholarly/theses/2004/Jun/04Jun_Cornelius.pdf

Cottle, Dean J. **Mine Avoidance and Localization for Underwater Vehicles Using Continuous Curvature Path Generation and Non-Linear Tracking Control**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1993. 74p.
ABSTRACT: Many underwater vehicles have been designed to follow a straight path using linear approximations about that path. Tracking a dynamic path of arbitrary but continuous curvature may often be desired. This will require a nonlinear controller with enhanced robustness properties. One point of this thesis is to show how nonlinear control using sliding modes may be applied to follow a dynamic path. In a mine warfare setting using Autonomous Underwater

Vehicles (AUVs), reflexive maneuvers will be required for nine avoidance. This thesis presents one way in which paths for mine avoidance maneuvers may be generated automatically and used as inputs to the nonlinear tracking control system of the vehicle. It has been shown through simulation that a random minefield can be traversed by an AUV while localizing and avoiding detected mines using these control concepts.

ACCESSION NUMBER: ADA276070

http://handle.dtic.mil/100.2/ADA276070

Crawford, Melvin W. and Robert L. Detwiler. **Through the Ice Mining Study**. Final report. Gaithersburg, MD: Epoch Engineering Inc., June 1983. 71p.

ABSTRACT: A search for literature relevant to ice penetration by naval mines has shown that interest in the problem has existed since 1952. Early studies were followed by Arctic sea ice penetration tests using instrumented penetrators of varying sizes and weights. Empirical equations for prediction of ice penetration and longitudinal accelerations during ice penetration were originally developed by modification of earth penetration equations. Analysis of all available test data has validated the empirical equations within the originally stated limits of accuracy. Comparable test data appear to confirm the validity for structural tests of penetration testing in gypsite as a simulation of Arctic sea ice for the first few feet of penetration. Very little information exists concerning transverse acceleration and loading in either ice or gypsite. Parametric studies of mine design parameters for a typical moored mine with practical constraints show trends of the weight area factor relationship and the nose shape factor relationship to maximum thickness of ice perforation capability, the payload to penetration relationship and the weight efficiency of the payload in a constrained total weight system. The few data available suggest that the problem of structural survival of transverse loads may be far more severe than that of surviving the longitudinal deceleration forces.

ACCESSION NUMBER: ADA174310

http://handle.dtic.mil/100.2/ADA174310

Davis, Duane T. **Precision Control and Maneuvering of the Phoenix Autonomous Underwater Vehicle for Entering a Recovery Tube**. Master's thesis. Monterey, CA: Naval Postgraduate School, Department of Computer Science, September 1996. 206p.

ABSTRACT: Because Underwater limitations imposed by speed and power supplies, covert launch and recovery of Autonomous Underwater Vehicles (AUVs) near the operating area will be required for their use in many military applications. This thesis documents the implementation of precision control and planning facilities on the Phoenix AUV that will be required to support recovery in a small tube and provides a preliminary study of issues involved with AUV recovery by submarines. Implementation involves the development of low-level behaviors for sonar and vehicle control, mid-level tactics for recovery planning, and a mission planning system for translating high-level goals into an executable mission. Sonar behaviors consist of modes for locating and tracking objects, while vehicle control behaviors provide the ability to drive to and maintain a position relative to a tracked object. Finally, a mission-planning system allowing graphical specification of mission objectives and recovery parameters is implemented. Results of underwater virtual world and in-water testing show that precise control based on sonar data and its use by higher-level tactics to plan and control recovery. Additionally, the mission-planning expert system has been shown to reduce mission planning time by approximately two thirds and results in missions with fewer logical and programming errors than manually generated missions.

ACCESSION NUMBER: ADA325015

http://handle.dtic.mil/100.2/ADA325015

http://edocs.nps.edu/npspubs/scholarly/theses/96Sep_Davis.pdf

Denning, Gary M. **Mine Countermeasures: Tomorrow's Operations -- Today's Implications**. Final report. Newport, RI: Naval War College, February 1997. 23p.
ABSTRACT: Among the most cost effective weapons available to Third World nations are naval mines. Naval mines provide a small navy with an asymmetrical means to counter a much larger and more capable navy. As the United States discerned during Desert Storm, naval mines, more than any other weapon encountered, had the potential to deny access to U.S. vital objectives, block U.S. naval power projection, and jeopardize the steady flow of sustainment. The U.S. Naval Services and its MCM force took away several lessons learned from Desert Storm. They have since responded to these lessons by restructuring MCM organization and accelerating its research and development for technological improvements. While these are key takeaways, it remains to be seen whether or not the Naval Services learned the most significant lesson: MCM operations will ultimately fail unless considered as a component of the overall campaign or operational plan. The combatant commander has the ability to correct the greatest MCM deficiency of all right now. His greatest asset to minimize the mine threat is his own operational judgment. If naval expeditionary forces are to successfully dominate tomorrow's littorals, today's combatant commander must integrate MCM operations into his standing plans.
ACCESSION NUMBER: ADA325248
http://handle.dtic.mil/100.2/ADA325248

DeRiggi, D. F. **Analysis of Variance of the Countermine Experiment (CME).** Alexandria, VA: Institute for Defense Analyses, October 1997. 59p.
ABSTRACT: The Countermine Experiment, conducted at the Mounted Warfare Testbed at Ft Knox, KY in July of 1996 by this Night Vision Sensors Division of Ft Belvoir, VA and the Engineer Battle Testbed of Ft Leonard Wood, MO, was a classic 2 to the 3rd factorial experiment. It examined three classes of countermine systems in which each class had two representations. The three categories of countermine systems were aerial surveillance, ground surveillance, and explosive breaching systems. An analysis of variance performed on the number of Blue vehicles lost during this experiment indicates that the aerial surveillance system is the most significant factor in reducing Blue losses to mines.
REPORT NUMBER: IDA-D-2011
ACCESSION NUMBER: ADA333342
http://handle.dtic.mil/100.2/ADA333342

DeWeerts, Michael J. **Detection of Underwater Military Munitions by a Synoptic Airborne Multi-Sensor System**. Honolulu, HI: BAE Systems Spectral Solutions, 2010. 33p.
ABSTRACT: Many active and former military installations have ranges and training areas that include adjacent water environments that pose technical challenges for cleanup of unexploded ordnance (UXO). This SERDP project was aimed at testing advanced technologies, originally developed for mine detection under the Synoptic Airborne Multi-Sensor System (SAMSS) program, for underwater UXO detection. Multiple technologies were investigated during the project including multispectral imaging REVEAL (Rapid Efficient Volumetrically-EnAbled Lidar) and lidar shearography. Of the three technologies, two (MSI imagery and REVEAL lidar) were tested simultaneously from the Makai Pier in Oahu against the same target fields. However, while results from each of the three technologies were promising, more work needs to be done to ensure a fused synoptic solution can be achieved.
ACCESSION NUMBER: ADA534213
http://handle.dtic.mil/100.2/ADA534213

Diaz, J. Enrique Reyes. **Assigning Unmanned Undersea Vehicles (UUVs) to Mine Detection Operations**. Monterey, CA: Naval Postgraduate School, December 1999. 59p.

ABSTRACT: In an era when mines are inexpensive and easily accessible, present mine detection and area reconnaissance capabilities are insufficient to enable unencumbered maneuver in the littoral regions. Unmanned undersea vehicles (UUVs) possess potential to provide tactical commanders with full understanding of the mine threat without risk to ships or personnel and without exposing intentions. By integrating an assortment of emerging capabilities, a system comprised of a variety of UUVs could address this mine threat. This thesis develops and implements the Mine Reconnaissance System Assessment (MiRSA) model, a mixed integer-linear program, to assign a mix of UUVs to search areas within a suspected minefield. Using unclassified UUV performance estimates, this thesis compares combinations of two Long-term Mine Reconnaissance System (LMRS) vehicles, six Remote Environmental Monitoring Units (REMUS) vehicles, and a notional Manta vehicle. For a 262 square nautical mile area in the Straits of Hormuz, MiRSA finds the two LMRS vehicles can complete a 95% confidence level search in 91 hours, the Manta vehicle can complete the search in 130 hours, and the two LMRS vehicles with Manta employed optimally together require only 52 hours. For an exhaustive search, times rise sharply: Manta operating alone requires 1,004 hours and optimal employment of the two LMRS, six REMUS, and Manta vehicles finish the search in 384 hours.

ACCESSION NUMBER: ADA376124

http://handle.dtic.mil/100.2/ADA376124
http://edocs.nps.edu/npspubs/scholarly/theses/99Dec_Diaz.pdf

Discenza, Joseph H. and Peter P. Haglich. **Structured Essential Model for Mine Warfare**. Hampton, VA: Wagner (Daniel H.) Associates, Inc., 12 February 1996. 372p.

ABSTRACT: Report developed under SBIR contract for N94-217. This report describes the proposed system, 'Structured Essential Model for Mine Warfare', (SEMMIW). The report provides class diagrams, class specifications, object- scenario diagrams, and descriptions, all in the Booch notation. It also provides a mathematical foundation for predicting the expected number of remaining mines, given INTEL estimates and given the results of mine search operations.

REPORT NUMBER: DHWA-6230
ACCESSION NUMBER: ADA384594

http://handle.dtic.mil/100.2/ADA384594

Dubsky, Barbara K. **U.S. and Australian Mine Warfare Sonar Performance Assessment Using SWAT and Hodgson Models**. Monterey, CA: Naval Postgraduate School, September 2000. 211p.

ABSTRACT: The purpose of this thesis was to investigate a shallow coastal region to compile a detailed environmental picture of its sediment composition and water characteristics and from this model MCM sonar performance at the FBE-H exercise location as a means to determine what parameters exerted the greatest effect on performance. Seven parameters were intercompared to assess their sensitivity in detecting mines: bottom type, SSP, water depth/sonar depth, mine depth, frequency, sonars and models. Performance was assessed using several measures of effectiveness including the signal to noise ratio and initial detection range. Variations in these measures were analyzed by investigating how TL and RL responded to changing parameters. No one single parameter was identified that affected sonar performance significantly above all others. Of the environmental parameters considered, variations in bottom type exerted the most influence on TL and RL and ultimately on sonar performance. IL was clearly a significant factor when the bottom type is comprised of absorptive, fine-grained material. Of the sonar parameters, frequency exerted a significant impact on performance with TL the most sensitive term in this comparison. A higher TL associated with higher frequency reduced the signal level *and consequently the bottom RL. The higher frequency displayed a stronger SNR than the lower frequency over short ranges, however the higher frequency was limited by TL at greater ranges with the lower frequency achieving greater initial detection ranges.*

ACCESSION NUMBER: ADA384644

http://handle.dtic.mil/100.2/ADA384644

Dye, David C. **High Frequency Sonar Components of Normal and Hearing Impaired Dolphins**. Monterey, CA: Naval Postgraduate School, 2000. 85p.

ABSTRACT: A data acquisition device was constructed and tested to obtain toothed whale (Bottlenose Dolphin and Beluga Whale) sonar signals and digitally store them to a PC hard drive. The device had the capability of capturing sonar signals by means of a two-hydrophone array, and a digital video camera in a submersible housing. Cooperation with marine biologists at SSC San Diego enabled the sampling of three animals performing echolocation tasks. Their sonar signals, transmissions of rapid high frequency pulses called clicks, were recorded for further processing. Once the data was captured on video and hard disk drive, it was processed using MATLAB. Data from three different toothed whales, a normal Bottlenose Dolphin, a Bottlenose Dolphin with a hearing impairment and a Beluga Whale, was analyzed. It was observed that the animals reduced the interval between clicks when they located a target. Correlating the signal data to the video data made this observation possible. It appeared the animals searched with widely spaced clicks, then narrowed the click period upon target detection. Also, it was noted that the frequency of isolated clicks decreased as click period decreased. However, the hearing impaired Dolphin maintained his click frequency regardless of click periodicity.

ACCESSION NUMBER: ADA384477

http://handle.dtic.mil/100.2/ADA384477

http://edocs.nps.edu/npspubs/scholarly/theses/2000/Sep/00Sep_Dye.pdf

Elischer, P. and J. Howe. **Australia's Shock Testing Capability.** Canberra (Australia): Defence Science and Technology Organisation, 11 February 1993. 9p. [Proceedings from the Institution of Engineers, Australia Dynamic Loading in Manufacturing and Service Conference Held in Melbourne, Victoria on 9-11 February 1990.]

ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP), minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program and the various research tasks undertaken by DSTO. This paper presents an overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water.

_______. Dynamic Loading in Manufacturing and Service: Australia's Shock Testing Capability. Ascot Vale (Australia): Materials Research Laboratories, 11 February 1993. 9p.

ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP) minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program *and the various research tasks undertaken by DSTO. An overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water is presented.*

ACCESSION NUMBER: ADA268334

http://handle.dtic.mil/100.2/ADA268334

Elliott, Myron A. **Acoustic Transient Generator.** Patent. Washington, DC: Department of the Navy, filed 4 August 1964, patented 2 October 1990. 9p.

ABSTRACT: This patent pertains to an underwater transient sound generator for broadcasting optimum acoustical sonic energy in sea water with an appropriate intensity and frequency spectrum to achieve passivation of acoustical mines. A high pressure bubble is released from a chamber while a resilient diaphragm is simultaneously vibrated, the diaphragm having at least one of its surfaces in contact with the sea water. The system provides an improved pneumatic-mechanical impact sound source that produces a controllable distribution of high power, broad band spectrum acoustical energy, to temporarily inactivate acoustical mines, while masking the noise of the ship as it passes the mine.

REPORT NUMBER: **PATENT: 4**,**961**,**181**

http://www.uspto.gov/patft/

Elmore, Paul A. and Michael D. Richardson. **Regional Mine Burial Prediction Using Monte Carlo and Deterministic Methods**. Stennis Space Center, MS: Naval Research Laboratory, 2003. 9p.

ABSTRACT: An integrated, time-dependent, stochastic model for predicting mine burial in littoral waters is presented. The model is designed to account for impact burial of mines and coupled post-impact burial processes (scour, sand ridge migration, and liquefaction) by integrating currently available deterministic models that predict these burial processes. Operational Navy databases and oceanographic modeling output from the United States Naval Oceanographic Office (NAVOCEANO) are used to Set up the initial bathymetric and sediment conditions and provide the temporal driving burial forces. The model uses Monte Carlo simulations to provide stochastic burial predictions based on mine geometry and various deployment scenarios. Temporal changes in burial conditions may be displayed on a regional map.

ACCESSION NUMBER: ADA426525

http://handle.dtic.mil/100.2/ADA426525

Emery, Mark H. and Philip J. Valent. **Constitutive Modeling of Air and Water Saturated Sand for Shock Propagation Modeling**. Workshop Summary and Recommendations. Washington, DC: Naval Research Laboratory, 7 April 1995. 16p.

ABSTRACT: The mine countermeasure research program is an Office of Naval Research program that addresses the physical characterization and modeling of the surf zone environment, explosive shock propagation and mitigation in this environment, and the means to improve the performance prediction of mine countermeasure efforts in the surf zone. This report summarizes the results of the Workshop on Constitutive Modeling of Air and Water Saturated Sand for Shock Propagation Modeling sponsored by the Naval Research Laboratory. The objectives of this workshop were to appraise the present state of knowledge with respect to the characterization of the air and water saturated sandy medium, the experimental evidence for shock mitigation and propagation in this medium, the present constitutive modeling capabilities, and to develop a focused research effort to address the complex physics issues related to this task. Participants discussed issues associated with mine countermeasure systems including shock wave propagation in sandy sediments with water and free-air pore fluid, measurement of the

mechanical properties of both dry and partially saturated sand, hydrodynamic modeling of this environment, and continuum and micromechanical aspects of constitutive models. (MM).
REPORT NUMBER: **NRL/MR/6440-95-7658**
ACCESSION NUMBER: ADA293295
http://handle.dtic.mil/100.2/ADA293295

Engebretson, Kent R. **Comparison of Data Fusion Techniques for Target Detection With a Wide Azimuth Sonar**. Master's thesis. Wright-Patterson AFB, OH: Air Force Institute of Technology, May 1995. 127p.
ABSTRACT: A group at the Charles Stark Draper Laboratory developed a concept for a mine reconnaissance platform called Intelligent Sonobuoy. This platform utilizes a low frequency sonar with wide aspect angle coverage. Furthermore the platform is designed to drift past an area of interest and thus obtain multiple detections from each sonar target. This thesis examines methods of fusing together those detections into a composite map of the target field in order to detect and localize those sonar targets. A technique based on hypothesis testing and maximum likelihood estimation is first derived and then applied to simulated data. Lastly, the system is validated on actual test data obtained in Mendum's Pond, New Hampshire during the summer and Fall of 1994. This system is shown to be effective at resolving targets to within a few meters. A competing approach based on the Hough transform is next examined. This clustering technique is applied to find the change in target location with respect to the buoy's position. The system works for simulated test data with a small number of detections. System performance declines rapidly as the number of detections increases and the system does not work well with the actual test data.
ACCESSION NUMBER: ADA296540
http://handle.dtic.mil/100.2/ADA296540

Evans, Ashley D. **Hydrodynamics of Mine Impact Burial**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 2002. 407p.
ABSTRACT: A general physics based hydrodynamic flow model is developed that predicts the three-dimensional six degrees of freedom free fall time history of a circular cylinder through the water column to impact with an unspecified bottom. Accurate vertical impact velocity and impact angle parameters are required inputs to subsequent portions of any Impact Mine Eurial Model. The model vertical impact velocity and impact angle are compared with experimental data, vertical impact velocities and impact angle to validate the model mechanics and accuracy. The three dimensional model results are compared through the experimental data with IMPACT28 vertical impact velocities and impact angle. Results indicate the three dimensional model mechanics are sound and marginal improvements are obtained in predicted vertical velocities. No improvement is gained using the three-dimensional model over the IMPACT28 model to predict impact angle. The three dimensional model produces dispersed results for impact angle The observed stochastic nature of mine movement in experimental data suggests this three dimensional model be used to model the hydrodynamic flow phase in a statistical mine burial model that provides distributions for input parameters, and domain characteristics and present a probabilistic output for development of a relevant navy tactical decision aid.
ACCESSION NUMBER: ADA408073
http://handle.dtic.mil/100.2/ADA408073
http://edocs.nps.edu/npspubs/scholarly/theses/2002/Sep/02Sep_Evans.pdf

Evans, B., et al. **Implementation of Autonomous Mission Control for Mine Reconnaissance AUVs**. La Spezia, Italy: NATO Undersea Research Centre, 2007. 15p.

ABSTRACT: Whilst autonomous underwater vehicles (AUVs) are increasingly being used to perform MCM tasks, the capability of these systems is limited in terms of their ability to network and co-operate effectively with other manned or unmanned assets. This paper describes a processing system which is being developed at NURC to address this missing capability. In addition to describing the system approach and implementation progress, the underlying requirement for the system is analyzed through a review of typical mission needs and the performance constraints of current technology.

ACCESSION NUMBER: ADA478687

http://handle.dtic.mil/100.2/ADA478687

Fambroo, III, Dillard H. **A Combat Simulation Analysis of the Amphibious Assault Vehicle in Countermine Operations**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1999. 74p.

ABSTRACT: The purpose of this thesis is to evaluate the effectiveness of an Amphibious Assault Vehicle (AAV) as a mine countermeasure in the surf zone and beach zone (sz/bz). In order to show the utility of these approaches, this thesis presents results from three different scenarios. Scenario one provides a baseline and is conducted with the amphibious landing force moving onshore with no minefield breaching operations being conducted. Scenario two encompasses a more traditional method of minefield breaching. Scenario three will use AAVs only to breach the surf zone and beach zone minefields. The focus will be placed on the number of mines neutralized as well as the number of assets killed.

ACCESSION NUMBER: ADA370835

http://handle.dtic.mil/100.2/ADA370835

http://edocs.nps.edu/npspubs/scholarly/theses/99Sep_Fambroo.pdf

Feldes, Waldemar and Volker Hausbeck. **TROIKA**, **The West German Navy's New Mine Countermeasures System (TROIKA**, **das neue Minenabwehrsystem der Marine).** Washington, DC: Naval Intelligence Support Center, Translation Division, April 1978. 12p. Translation of **Soldat und Technik** (West Germany) no. 11, p. 600-606, 1977.

ABSTRACT: None available.

REPORT NUMBER: NISC-TRANS-4017

ACCESSION NUMBER: ADA055035

http://handle.dtic.mil/100.2/ADA055035

Fowler, Jimmy E., et al. **Field Study on the Effects of Waves and Currents on a Distributed Explosive Array**. Final report. Vicksburg, MS: Coastal Engineering Research Center, December 1993. 82p.

ABSTRACT: Field tests to assess the effects of waves and currents were conducted during the summer of 1993 at CERC's Field Research Facility (FRF) in Duck, NC. This test series is a follow-on to similar efforts accomplished in 1992 and was designed to incorporate lessons learned from those efforts. Major differences between the 1993 tests and those conducted in 1992 involved the use of a wider array, a compressed air gun to simulate the dual-rocket deployment technique, and shore-based tethers to stabilize the deployed array. Results of the 1993 field tests generally supported 1992 findings, which indicated that both waves and longshore currents have significant effects on the explosive array deployment system and must *be considered in the final design. The tests also indicated that wide arrays used in conjunction with the tethers proved to be quite stable under the environmental conditions tested.*

ACCESSION NUMBER: ADA275478

http://handle.dtic.mil/100.2/ADA275478

Fowler, Robert W. **Mine Countermeasures at the Operational Level of War.** Final report. Newport, RI: Naval War College, Department of Operations, 12 November 1993. 32p.

ABSTRACT: This paper examines the complex problems and difficulties facing an operational commander when conducting operations in a mine threat environment. A discussion of mine warfare history, operational considerations, and today's mine countermeasure assets as well as a hypothetical situation that a commander may actually be faced with in today's global crisis-oriented climate is considered. The ability of the U.S. Navy to accomplish its primary strategic goal of Power Projection in a mine-threat environment is extremely difficult and limited. The panacea for present day MCM operations is recognition of the threat, knowledge of own capabilities, fleet training, and frugal management of MCM assets.

ACCESSION NUMBER: ADA265300

http://handle.dtic.mil/100.2/ADA265300

Gellert, E. P., et al. **Use of Composites in Naval Structures**. Ascot Vale (Australia): Materials Research Laboratories, 1992. 20p.

ABSTRACT: Composite materials in the form of glass-fiber reinforced plastic (GRP) and GRP/foam sandwich are being increasingly applied to naval vessel construction. Candidate materials will respond differently to elevated temperatures, moist environments and fires. Some of the effects are described here. The bolted jointing of GRP to steel has been assessed.

ACCESSION NUMBER: ADA270308

Gilbert, Jason A. **Combined Mine Countermeasures Force: A Unified Commander-in-Chief's Answer to the Mine Threat**. Newport, RI: Naval War College, Joint Military Operations Department, 5 February 2001. 26p.

ABSTRACT: The threat of mines presents a Unified commander-in-Chief (CINC) with problems affecting the time-space-force aspects of his command. Further complicating this matter, is the U.S. Navy's inability to adequately address the mine threat problem unilaterally. History demonstrates that the U.S. Navy's inability to maintain a mine countermeasures (MCM) force sufficiently large enough and technologically advanced enough has been nominally off-set by the strengths of a combined MCM force. Joint Doctrine supports the forming of alliances and coalitions, whenever possible, in order to integrate the capabilities of other nations and to promote regional stability. The complexities associated with combined forces are simplified by the characteristics and political appeal of MCM, making it attractive to the CINC and potential partner-nations. Given that mines will remain a threat complicating a CINC's ability to effectively direct the operations of his forces, and that there is a legitimate need to solve the U.S. Navy's MCM deficiencies, a CINC will be able to train as he would fight and positively influence regional stability by planning for a combined MCM force.

ACCESSION NUMBER: ADA390327

http://handle.dtic.mil/100.2/ADA390327

Glaz, Jospeh. **Statistical Methods for Minefield Detection**. Interim report. Storrs, CT: Connecticut University, Department of Statistics, 24 May 1994. 12p.

ABSTRACT: The Navy and the Marine Corps have been continually concerned about the antivehicle and antiship mines. The development of effective minefield detection procedures are of great importance as they will enhance the ability of the Navy and Marine Corps to perform their *tasks. One approach that has been recently studied by the scientists of the Navy is the use of tests of randomness. In that study they express the need to develop detection methods that are based on two-dimensional processes that incorporate the dependence structure of the nearby observations. In this interim performance report four research projects related to this problem are discussed. The two-dimensional scan statistic, discussed in the last project, has the potential to be very useful in the minefield detection problem.*

ACCESSION NUMBER: ADA282161
http://handle.dtic.mil/100.2/ADA282161

Gooding, Trent R. **Framework for Evaluating Advanced Search Concepts for Multiple Autonomous Underwater Vehicle (AUV) Mine Countermeasures (MCM).** Cambridge, MA: Massachusetts Institute of Technology, Department of Ocean Engineering, February 2001. 114p.

ABSTRACT: Waterborne mines pose an asymmetric threat to naval forces. Their presence, whether actual or perceived, creates a low-cost yet very powerful deterrent that is notoriously dangerous and time-consuming to counter. In recent years, autonomous underwater vehicles (AUV) have emerged as a viable technology for conducting underwater search, survey, and clearance operations in support of the mine countermeasures (MCM) mission. With continued advances in core technologies such as sensing, navigation, and communication, future AUV MCM operations are likely to involve many vehicles working together to enhance overall capability. Given the almost endless number of design and configuration possibilities for multiple-AUV MCM systems, it is important to understand the cost-benefit tradeoffs associated with these systems. This thesis develops an analytical framework for evaluating advanced AUV MCM system concepts. The methodology is based on an existing approach for naval ship design. For the MCM application, distinct performance and effectiveness metrics are used to describe a series of AUV systems in terms of physical/performance characteristics and then to translate those characteristics into numeric values reflecting the mission-effectiveness of each system. The mission effectiveness parameters are organized into a hierarchy and weighted, using Analytical Hierarchy Process (AHP) techniques, according to the warfighter's preferences for a given operational scenario. Utility functions and modeling provide means of relating the effectiveness metrics to the system-level performance parameters. Implementation of this approach involves two computer-based models: a system model and an effectiveness model, which collectively perform the tasks just described. The evaluation framework is demonstrated using two simple case studies involving notional AUV MCM systems. The thesis conclusion discusses applications and future development potential for the evaluation model.

ACCESSION NUMBER: ADA387798
http://handle.dtic.mil/100.2/ADA387798

Graves, Steven M. **Internetworking: Airborne Mine Countermeasures C4I Information Systems**. Master's thesis. Monterey, CA: Naval Postgraduate School, December 1996. 106p.

ABSTRACT: Airborne Mine Countermeasures (AMCM) Command Control Communication Computer and Intelligence (C4I) baseline currently consists of stand-alone tactical decision aids. Information such as aircraft position, equipment status, and abbreviated mine-like contact reports cannot be transferred in any form other than voice from/to the MH-53E helicopters while conducting Airborne Mine Countermeasures operations. There are currently no methods to transfer sonar video or single-frame imagery of mine-like objects between any Mine Warfare (MIW) units in a near-real-time manner. Delays lasting several hours are frequently encountered before the results of a 'rapid reconnaissance' airborne mine-hunting mission are made available to the rest of the fleet and/or MIW community. In order to improve command and control, the AMCM Mine Warfare community must integrate all of its C4I assets onto a tactical internet. This thesis presents a tactical internet for AMCM with an open, standards-based modular architecture. It is based on the TCP/IP network model using common protocols and interfaces. Command and *control will significantly improve as this network will provide a methodology to transfer critical information between AMCM C41 assets and tactical networks world-wide.*

ACCESSION NUMBER: ADA328259

http://handle.dtic.mil/100.2/ADA328259

http://edocs.nps.edu/npspubs/scholarly/theses/96Dec_Graves.pdf

Griffin, Sean, et al. **An Improved Subsequent Burial Instrumented Mine**. New Orleans, LA: Omni Technologies, 2002. 9p.

ABSTRACT: Detection of buried mines using conventional sonars is difficult, especially in complex coastal environments, which complicates naval tactical decisions such as whether to hunt, sweep, or avoid a mined area. The U.S. Navy is therefore supporting research to develop and validate stochastic, time- dependent, mine burial prediction models. This research requires continuous monitoring of both mine behavior during burial and the near-Held processes responsible for burial. Modes of burial are generally separated into two broad categories: impact burial and subsequent burial (scour and fill, creep, liquefaction, and bedform modification). Omni Technologies, Inc. (OTI) and the Naval Research Laboratory (NRL) have developed instrumented mines that measure both subsequent mine burial behavior and the processes that initiate and effect burial. In this paper we describe new instrumented mines, including acoustic sensors used to measure burial and sensors used to measure mine orientation, azimuth and movement. Sensors and methods used to measure characteristics of surface gravity waves, direction and magnitude of bottom currents, turbulent flow near the mine, initiation of bedload motion, and sediment size and concentration in the water column are also described.

ACCESSION NUMBER: ADA408365

http://handle.dtic.mil/100.2/ADA408365

Hall, Patrick W. **Detection and Target-Strength Measurements of Buried Objects Using a Seismo-Acoustic Sonar**. Master's thesis. Monterey, CA: Naval Postgraduate School, December 1998. 73p.

ABSTRACT: This thesis describes the results of field experiments in which seismo-acoustic interface (Rayleigh) waves were employed to detect and measure the target strength of mine-like test objects buried in the near-surf zone. These experiments were conducted as part of an ongoing NPS research program to develop a seismo-acoustic sonar system for the detection of buried mines in the surf and, near-surf zones. An experimental seismo-acoustic sonar system, using linear force actuators as the wave source and three-axis seismometers as receivers, was deployed at a beach test site. The target strengths of two mine- like test objects, a compressed gas cylinder and a gunpowder can, were measured as a function of target mass and for various emplacement conditions, e.g. very wet sand, not very wet sand, partially buried, completely buried, completely buried and washed over for several days. "Vector polarization filtering" was employed to separate the reflected signal due to Rayleigh waves, for which the particle motion is elliptical, from that of body (P and S) waves, for which the particle motion is linear. The target strength was generally found to increase with increasing target, mass. Typical values observed ranged from approximately -20dB to -10dB for target masses of 70 to 290 kg. Curiously, it was observed that the elliptical particle motion of the reflected wave was of the opposite polarity for those targets which were buried, but slightly exposed, compared to those which were completely buried. It is not known at this time whether this is due to the depth-dependent properties of Rayleigh waves, or whether it is a result of the conditions of source and target emplacement.

ACCESSION NUMBER: ADA359103

http://handle.dtic.mil/100.2/ADA359103

http://edocs.nps.edu/npspubs/scholarly/theses/98Dec_Hall.pdf

Harris, Daniel E. and Don W. Shepherd. **Structured Approach to the Articulation of Future Mine Countermeasure Concepts**. Panama City, FL: Coastal Systems Station, 21 March 2000. 11p.

ABSTRACT: This paper presents an approach to developing a structure derived from the point of view that mine countermeasures is a core Navy function independent of whether dedicated or organic systems and platforms perform that function. It is an appreciated fact that mine countermeasures is a complex warfare task that will play an increasingly important role in naval operations as the Navy continues to implement the littoral warfare strategy. In the future, implementation of the naval strategy will require an expanded view of mine countermeasures. The main battle force components will be required to possess organic capabilities to deal with the threat of mines through a cooperative engagement capability approach. This paper focuses on articulating an overall framework that can be regarded as the point of departure toward defining and implementing a mine countermeasure capability fully compatible with, and integrated into, fleet operations.

ACCESSION NUMBER: ADA376388

http://handle.dtic.mil/100.2/ADA376388

Harris, Michael, et al. **Acquiring Bathymetry Data With the VSS Sonar on the AQS-20 Mine Hunting System**. Stennis Space Center, MS: Naval Research Laboratory, Marine Geosciences Division, 29 March 2001. 10p.

ABSTRACT: A goal of future naval development is to utilize fleet systems to acquire ocean environment measurements for tactical use on the spot'. A preliminary evaluation of data indicates that a future operational mine hunting system can provide needed bathymetry data in regions where adequate data does not exist. In this paper, bathymetric data is obtained from the Volume Search Sonar (VSS) on the Engineering Development Model (EDM) AN/AQS-20 Sonar, Mine Detecting Set to illustrate the capability. This system is a helicopter-towed mine hunting system with the capability to obtain coarse bathymetry data. The data are sufficient to meet the accuracy requirements for mine warfare operations.

REPORT NUMBER: NRL/PP/7440-01-1002

ACCESSION NUMBER: ADA388946

http://handle.dtic.mil/100.2/ADA388946

Harris, Michael, et al. **Environmental Data Collection from the AQS-20**. Stennis Space Center, MS: Naval Research Laboratory, Marine Geosciences Division, 11 June 2002. 14p.

ABSTRACT: The Naval Research Laboratory (NRL) under the technical direction of SPAWAR PMW-155 and the sponsorship of the Oceanographer of the Navy, N096, examined the technical feasibility of extracting environmental data from the AQS-20 Mine Hunting Sonar towed from both the MH-60 helicopter and the AN/WLD- I Remote Mine Hunting System. Multibeam bathymetry and sediment information can be extracted from the AQS-20 and used in near real- time in tactical decision aids like the Mine Warfare Environmental Decision Aids Library (MEDAL). These conclusions are based on AQS-20 experiments conducted in June 1998, July 1999 and June 2001. This paper discusses the advantages of near real-time environmental data in MCM and describes a proposed Environmental Data Collection (EDC) Mode of operation for the AQS-20.

ACCESSION NUMBER: ADA406765

http://handle.dtic.mil/100.2/ADA406765

Hawkins, Darrin L. and Barbara C. Van Leuvan. **An XML-Based Mission Command Language for Autonomous Underwater Vehicles (AUVs).** Master's thesis. Monterey, CA: Naval Postgraduate School, 2003. 114p.

ABSTRACT: Autonomous Underwater Vehicles (AUVs) are now being introduced into the fleet to improve Mine Warfare capabilities. Several AUVs are under government-contracted development. Mission planning and data reporting vary between vehicles and systems. This variance does not pose an immediate problem, as only one AUV is currently in production. However, as more AUVs are put into production, commands will begin to get multiple AUVs. Without a single mission command language, multiple systems will require familiarity with multiple languages. Extensible Markup Language (XML) and related technologies may be used to facilitate interoperability between dissimilar AUVs and extract and integrate mission data into Navy C4I systems. XML makes archive maintenance easier, XML documents can be accessed via an http server, and, in root form, XML is transferable on the fly by stylesheet. This thesis presents an XML-based mission command for the command and control of AUVs. In addition, this thesis discusses XML technology and how XML is a viable means of achieving interoperability. Furthermore, this thesis provides an example mission file using existing software, and demonstrates the future of XML in AUV technology. Finally, this work ends with a compelling argument for the use of an XML-based mission command language to command all AUVs.

ACCESSION NUMBER: ADA417509

http://handle.dtic.mil/100.2/ADA417509

http://edocs.nps.edu/npspubs/scholarly/theses/2003/Jun/03Jun_Hawkins.pdf

Holden, Kevin T. **Mine Countermeasures: What the Operational Commander Must Know**. Newport, RI: Naval War College, Department of Operations, 8 February 1994. 35p.

ABSTRACT: A great deal has been written concerning the need for more and improved mine countermeasures equipment. What seems lacking is adequate focus at the operational level regarding how to effectively and efficiently employ existing systems in support of current and future operations. In many situations, to achieve a military objective, it is essential the operational commander know the existing or potential mine threat, understand current mine countermeasure capabilities, determine the available courses of action, and select the course of action that will provide the highest probability of success in support of an assigned mission. This paper is intended to emphasize the importance of mine countermeasures to the operational commander. It draws upon the lessons of history to show that mine warfare has had a significant impact on naval and joint operations. while the paper addresses some technical and tactical aspects of mine countermeasures, the primary focus is on the operational considerations and options available to the operational commander.

ACCESSION NUMBER: ADA279712

http://handle.dtic.mil/100.2/ADA279712

Hong, Young S. **Improved Prediction of Drift Forces and Moment**. Final report. Bethesda, MD: David W. Taylor Naval Ship Research and Development Center, September 1983. 43p.

ABSTRACT: A three-dimensional method is developed to improve the computation of the drift force and moment for small-waterplane-area, twin-hull (SWATH) and surface ships in oblique waves with zero forward speed. Numerical results have been computed for three ships: SWATH 6A, Stretched SSP, and MCM experiment. For MCM 5371, the results of two- and three-dimensional methods are almost identical to each other and these results show good agreement with experiment when the wavelength ratio is not too small. Even though there are no test data available for SWATH 6A, the application of three dimensional theory is likely to improve the results of drift force and moment for SWATH ships.

ACCESSION NUMBER: ADA134055

Hsieh, Chung-Ping. **Effect of Internal Solitary Waves on Mine Detection in the Western Philippine Sea East of Taiwan.** Monterey, CA: Naval Postgraduate School, 2006. 120p.

ABSTRACT: Upper layer temperature in the western Philippine Sea near Taiwan was sampled using a coastal monitoring buoy with fifteen thermistors attached from July 28 August 7, 2005. Internal waves and internal solitons (IS) were identified using the empirical orthogonal function analysis. Without the IW and IS, the power spectra, structure functions, and singular measures (representing the intermittency) of the temperature field satisfy the power law with multi-scale characteristics at all depths. The IW does not change the basic characteristics of the multifractal structure. However, the IS changes the power exponent of the power spectra drastically, especially in the low wave number domain. It breaks down the power law of the structure function and increases the intermittency parameter. The physical mechanisms causing these different effects need to be further explored further. The Comprehensive Acoustic Simulation System was applied to determine how the IS affect the mine detection by computing the transmission loss (TL) and the ray traces of range-dependent and range-independent cases during the IS period. The maximum TL difference is 20 dB. As a result, the mine detection probability will dramatically be reduced to 1% of the original detection probability.

ACCESSION NUMBER: ADA462544

http://handle.dtic.mil/100.2/ADA462544

http://edocs.nps.edu/npspubs/scholarly/theses/2006/Dec/06Dec_Hsieh.pdf

Hurley, William J., et al. **General Approach to Investing in the New Modeling and Simulation Tools With a Case Study: Naval Mine Countermeasures Programs**. Alexandria, VA: Institute for Defense Analyses, July 1995. 218p.

ABSTRACT: Recent advances in computing, networking and visualization have led to dramatic improvements in modeling and simulation (MS) capabilities. The key issue for DoD is how to successfully convert these impressive technical developments into useful tools for addressing DoD's needs. This study proposes a general framework for deciding how to invest in the new MS tools. The framework begins with an articulation of a key need facing the decision maker. It then addresses the potential roles for MS in meeting that need, the implied characteristics of the MS tools, their costs, value added, risks, funding, and management. It then repeats this process for a range of needs facing the decision maker, and, by looking for common elements and setting priorities, seeks to integrate the results across all of the needs into a single MS plan. As a case study, this process is applied to the area of naval mine countermeasures (MCM). No detailed road map for MS investment is given, but the issues that arise are described along with some methods that may be used to resolve them. A strawman approach to MCM MS investments is presented. This is a 'fleet first' approach which focuses initially on training, tactical development and mission rehearsal with later applications to acquisition once acceptance of the MS tools, and confidence in them, have been established. The general framework described should be applicable to any area where the benefits and costs of the new MS tools are under consideration.

ACCESSION NUMBER: ADA305451

http://handle.dtic.mil/100.2/ADA305451

Ingold, Barry W. **Key Feature Identification from Image Profile Segments Using a High Frequency Sonar.** Master's thesis. Monterey, CA: Naval Postgraduate School, December 1992. 67p.

ABSTRACT: Many avenues have been explored to allow recognition of underwater objects by a sensing system on an Autonomous Underwater Vehicle (AUV). In particular, this research analyzes the precision with which a Tritech ST1000 high resolution imaging sonar system allows the extraction of linear features from its perceived environment. The linear extraction algorithm, as well as acceptance criteria for individual sonar returns are developed. Test results showing the *actual sonar data and the sonar's perceived environment are presented. Additionally, position of the sonar relative to the perceived image is determined based on the identification of key points in the scene.... Autonomous Underwater Vehicle (AUV).*

ACCESSION NUMBER: ADA261926

http://handle.dtic.mil/100.2/ADA261926

Inman, Douglas L. and Scott A. Jenkins. **Scour and Burial of Bottom Mines: A Primer for Fleet Use**. SIO reference series no. 02-8. La Jolla, CA: Integrative Oceanography Division, Scripps Institution of Oceanography, University of California, San Diego, 2002.

Abstract: This primer is for fleet use as a means of rapid access to information on scour, burial, and re-exposure of bottom mines placed in nearshore waters. The format is easily adapted to a computer slide show where sequential illustrations such as progressive mine scour and burial could be in animated form. The illustrations detail mechanisms and burial rates characteristic of coastal and sediment type. The primer also addresses the ranges of uncertainty in mine burial estimates by showing burial dependence on mine characteristics and environmental factors. By providing both burial rate estimates and the probable error of those estimates, this primer facilitates tactical use and planning, particularly in areas of denied access. The emphasis here is on field experiments of the scour and burial of bottom mines in shallow and very shallow water (3 m - 61 m) and their comparison with simulations from computer models. However, the complexity of mine warfare and mine use makes it necessary to briefly discuss categories of mines, their basic components, and their means of delivery and planting. The reader is advised to consult the references for detailed information on these related topics. We understand that other studies of bottom mine burial have been made. Here, we report on those studies that have been declassified and made available to us.

ACCESSION NUMBER: ADA406602

http://handle.dtic.mil/100.2/ADA406602

http://repositories.cdlib.org/sio/reference/02-8

Integrated Logistics Support Management Plan for the Remote Minehunting System (RMS). Washington, DC: Naval Sea Systems Command, September 1991. 35p.

ABSTRACT: Provide a management plan for ensuring that support elements, for the Remote Minehunting System (RMS) are available for delivery upon turn-over of the of the RMS from CSS to the Fleet.

ACCESSION NUMBER: ADA255806

http://handle.dtic.mil/100.2/ADA255806

Jappinga, Elaine M. and Divyakant L. Patel. **Technical Transfer Report on a TNT Enzyluminescent Vapor Detection System.** Final technical report. Fort Belvoir, VA: Army Belvoir Research Development and Engineering Center, February 1991. 104p.

ABSTRACT: This report describes the historical breadboard effort with enzyluminescent 2,4,6-trinitrotoluene (TNT) vapor detection system. The system comprises a sample train, vapor generator, and luminescence detector using a TNT reductase enzyme. This breadboard system is the culmination of a long-term effort evolving from several programs that examined the TNT enzyluminescent and bioluminescent response of marine bacteria, antibodies, and enzymes under BRDEC auspices. This program was suspended by BRDEC because its slow reaction time (total more than 22-minutes sampling and detection time with a 0.25 part per trillion (ppt) TNT-in-air lower detection limit) and therefore cannot be used for mine detectors. This report discusses an engineering design analysis that was performed for a new configuration of an

enzyluminescent TNT vapor detection system that utilizes an integrated sample-reactor module to provide an estimated TNT rate-of-response of less than 60 seconds and a 0.0025 ppt minimum detectable concentration. This improvement can be of significant value in noncountermine applications. The most feasible and adaptable current application for the conceptual system is that of enclosure monitoring (building, room, etc.) for the presence of TNT vapors. The report describes system operation and use is examined in these applications.
REPORT NUMBER: BRDEC-TR-2499
ACCESSION NUMBER: ADA233444
http://handle.dtic.mil/100.2/ADA233444

Jones, Harry S., David B. Kirkpatrick and Robert G. Wilson. **Marine Mine**. Patent. Washington, DC: Department of the Navy, February 1980. 22p.
ABSTRACT: In a pressure responsive mine having a casing and an arming and firing circuit therein, a pressure responsive device is mounted in the casing and exposed to the pressure of the sea water, a second pressure responsive device mounted in the casing, a fluid connection between the first and second pressure responsive devices, a third pressure responsive device mounted in the casing, a restricted fluid pressure responsive connection between the second and third pressure responsive devices, and a circuit making and breaking device positioned in the restricted connection between the second and third pressure responsive devices and connected in the arming and firing circuit.
REPORT NUMBER: PATENT: 4,187,779
http://www.uspto.gov/patft/

Kaminski, Paul G. **Affordable Naval Mine Warfare**. Washington, DC: Office of the Under Secretary of Defense (Acquisition and Technology), 11 June 1996. 9p.
ABSTRACT: This report contains information concerning naval mine warfare. The document addresses threats and future naval mine warfare issues.
ACCESSION NUMBER: ADA339429
http://handle.dtic.mil/100.2/ADA339429

Karun, Ronald J. **Analysis of the Waterhammer Concept as a Mine Countermeasure System**. Monterey, CA: Naval Postgraduate School, September 2000. 64p.
ABSTRACT: The purpose of this thesis is to provide an analysis of the Waterhammer concept design. Waterhammer is a device intended to generate repetitive shock waves to clear a path through the very shallow water region for amphibious operations. These repetitive shock waves are intended to destroy obstructions and mines alike. This thesis analyzes the energy budget of the deflagration processes and the basic principles of shock waves and acoustic saturation. When the source amplitude is increased to very high levels, acoustic saturation sets in, a state in which the amplitude of the received signal approaches a limiting value, independent of the source amplitude. Acoustic saturation thus will set physical constraints in the design of Waterhammer. Furthermore, as the pulse propagates in the shallow water environment, reflections from the water's surface and bottom floor will spread (he energy in the water column thus reducing the energy density, These combined effects can affect the intended performance of Waterhammer. The results of the analysis in this thesis lead to the conclusion that Waterhammer may not be viable in its present concept design.
ACCESSION NUMBER: ADA384598
http://handle.dtic.mil/100.2/ADA384598
http://edocs.nps.edu/npspubs/scholarly/theses/00Sep_Karun.pdf

Keegan, John J. **Trajectory Planning for the Aries AUV**. Monterey, CA: Naval Postgraduate School, June 2002. 116p.
ABSTRACT: This thesis supports ongoing ONR research in the area of Autonomous Underwater Vehicles (AUVs) and Mine Warfare. It shows a simulation of a two- vehicle autonomous rendezvous using both along track and cross track position controllers. Conducting open water experiments with the ARIES AUV identified the added mass matrix and hydrodynamic coefficients of the longitudinal equation of motion. The results indicate that it will be possible to maneuver an AUV to a specific rendezvous point at a specified time. Two-vehicle rendezvous maneuvers are likely to be needed in multi-vehicle operations when data transfer between range-limited communications modems are used.
ACCESSION NUMBER: ADA405600
http://handle.dtic.mil/100.2/ADA405600
http://edocs.nps.edu/npspubs/scholarly/theses/2002/Jun/02Jun_Keegan.pdf

Kern, George E. **Mine Neutralization System**. Patent. Washington, DC: Department of the Navy, filed 22 March 1967, patented 4 December 1990. 7p.
ABSTRACT: This patent discloses a mine neutralization system having self-propelled explosive charges fired at submarine mines by a mine detection and fire control system.
REPORT NUMBER: PATENT: 4,975,888
http://www.uspto.gov/patft/

Kervern, G. **Fire-and-Forget Expendable Mine Disposal Concepts**. Thomson Sintra Activites Sous-Marines, Brest (France), 1996. 7p.
ABSTRACT: Classical minehunting operations are often divided in 4 stages: detection by sonar, classification by sonar, mine identification, and mine neutralization. Identification and neutralization are generally achieved by the same equipment: a man-guided underwater vehicle. This underwater vehicle usually performs mine identification with the help of a video camera and is designed large enough to carry a strong explosive charge capable of destroying the mine without excessive accuracy is positioning. This paper aims at proposing new concepts and scenarios of guidance according to the different kinds of minehunting sonar available, at determining the criteria for the design of acoustic sensors (with or without the cooperation of launching vessel sonars) for the guidance equipment at proposing target recognition methods, and finally at estimating probability of success for several concepts by means of software simulations. The first approach will highlight the need, as for missile design, for extended software simulations in the definition of neutralization scenarios and systems, and in performance assessments.
ACCESSION NUMBER: PB97-130561

Kessel, R.T**. Probabilistic Theory for the Design of Optimal Linear Discriminators of the Automated Detection of Objects in Sidescan Sonar Images**. Dartmouth, (Nova Scotia): Defence Research Establishment Atlantic, 2000. 30p.
ABSTRACT: Computerized pattern recognition can be used to help a sonar operator locate underwater objects in sidescan sonar images. This report presents the theory behind several linear discriminators, with a view to improving automated detection. The discriminators are formulated mathematically to be optimal insofar as they maximize the detection performance as defined under the Neyman-Pearson design criteria, with adjustments made to those criteria to suit the prior knowledge of both the objects sought & the local seafloor clutter. The emphasis throughout is on sea mine detection in naval operations. The theory gives practical insight & direction for the mine detection problem, showing, for instance, what kind of data should be extracted from target & clutter image libraries to get optimal detection performance; the possibility

of there being several optimal linear discriminators in the case when nothing is assumed about the local seafloor clutter; and the effect of prior de-meaning of images on detection performance.
ACCESSION NUMBER: MIC10202589

Kirkland, James L. **Electrical Cable Marker**. Patent. Washington, DC: Department of the Navy, filed 13 February 1975, patented 20 November 1990. 7p.
ABSTRACT: A marine mine control wire tagging system is disclosed as including a transmitter and a receiver, a mobile underwater vehicle having a launcher mounted thereon, a radio frequency signal tag loaded in said launcher, a sensor and a fire control system for launching said tag upon the detection of said marine mine control wire by the aforesaid sensor. If so desired, said transmitter and receiver may be mounted on a boat which also tows said underwater vehicle to a position in proximity with said control wire.
REPORT NUMBER: **PATENT: 4**,**972**,**388**
http://www.uspto.gov/patft/

_______. **Radio Frequency Phase Sensitive Wire Detector**. Patent. Washington, DC: Department of the Navy, filed 20 April 1973, patented 28 September 1993. 7p.
ABSTRACT: An underwater object detection system and method are described which utilize changing phase relationships between radio waves received by a moving underwater receiver, via a retransmitting underwater object, and radio waves received through air directly from a transmitter. The moving underwater receiver is characterized by an envelope or encapsulation of material of different radio wave propagation rate than that of the water medium, so that a markedly different phase change relation exists when the underwater receiver is in contact with the object.
REPORT NUMBER: PATENT: 5,**249**,**162**
http://www.uspto.gov/patft/

_______. **Regenerative Radio-Frequency Wire Detector**. Patent. Washington, DC: Department of the Navy, filed 7 January 1972, patented 14 September 1993. 8p.
ABSTRACT: A regenerative radio-frequency wire detector is disclosed which incorporates a radio antenna and a radio receiver connected thereto. A radio transmitter is timely energized by an output signal from the aforesaid radio receiver which, in turn, causes the transmitting of electromagnetic energy within the environment ambient to the wire to be detected. A commercial radio station or other source is employed as a covert initial energizer of the wire to be detected. When so energized, said wire re-radiates electromagnetic energy to the receiving antenna which starts the regenerative processing within the system loop constituting the radio receiving antenna, the radio receiver, the radio transmitter, the transmitting radio antenna, the wire, and the environmental medium or mediums within which it is disposed. Due to the amplification effected by the aforesaid regeneration process, the detection of marine mine command wires, for example, is facilitated.
REPORT NUMBER: PATENT: 5,**245**,**588**
http://www.uspto.gov/patft/

Kish, Louis A. **Acoustic Mine Countermeasures.** Patent. Washington, DC: Department of the Navy, filed 9 December 1963, patented 13 November 1990. 7p.
ABSTRACT: This patent discloses a mine sweeping method and related apparatus for achieving at least temporary passivation of underwater acoustic influence mines by the generation of particular underwater sounds of progressively increasing intensity. The water is acoustically pulsed by repetitively injecting into the water individual metered slugs of heated water, which water is heated to its saturation pressure but below the critical point. The metered slugs of heated water may be of the same or of progressively increasing size, i.e. weight, and can be released from a heated pressure chamber into the water from either a stationary array or from an array towed from a moving ship, and at a depth such that the expanding bubbles, produced by the change of state of the heated water, do not break the water surface. The rapid expansion of the metered slugs produce the desired sound output for temporarily rendering the acoustic influence mines passive actuating their anti-countermine circuits.
REPORT NUMBER: PATENT: 4,969,399
http://www.uspto.gov/patft/

Kleijnen, J. P. C. and G. A. Alink. **Validation of Simulation Models: Mine-Hunting Case-Study**. Research memorandum. Tilburg University (Netherlands). Department of Economics, February 1992. 38p.
ABSTRACT: Stringent validation requires that simulation and real-life responses have the same mean. The responses, however, may show not only sampling error but also measurement error. Moreover, simulated and real responses are not comparable if they are obtained under different environmental conditions or scenarios. Modules within the simulation model should be submitted to sensitivity analyses based on experimental design theory and regression analysis. A weaker validation procedure tests whether the estimated simulation and real responses are positively correlated (they do not necessarily have a common mean). These issues are illustrated through a study on mine hunting at sea by means of a sonar.
ACCESSION NUMBER: PB92-20891

Krauss, Henry J., Jr. **From the Sea in 1950: Lessons for the 21st Century from Operation Chromite**. Final report. Newport, RI: Naval War College, Department of Operations, 22 February 1993. 35p.
ABSTRACT: The Navy and Marine Corps' combined vision for the 21st Century is articulated in the joint White Paper . . . . From the Sea. The focus is designed to provide a direction for the Naval Expeditionary Forces to proceed in shaping its forces in support of the National Security Strategy. The new direction is to be shaped for joint operations and structured to build power from the sea, operating forward in the littoral regions of the world. The purpose of this paper is to conduct a historical study of the United States' last major amphibious operation, with joint/combined force during a major regional conflict. Current national demobilization trends mirror the strategic culture of the late 1940s. The study of Operation Chromite: The Inchon-Seoul Campaign of 1950, revealed a nation ill prepared to respond to a major regional conflict due to a precipitous demobilization. The operational art employed by General MacArthur during Operation Chromite capitalized on synchronized amphibious maneuver and interdiction to attack North Korean centers of gravity. The success of the operation highlighted the importance of understanding the operational art, pursuing specialized amphibious training, and maintaining the capability of generating superior firepower. The weaknesses our Naval Service will bring into the 21st Century for a littoral Navy are insufficient naval gunfire, mine countermeasures, and amphibious lift resources.... National Security Strategy and Amphibious Operations.
ACCESSION NUMBER: ADA264284
http://handle.dtic.mil/100.2/ADA264284

Lane, Richard N. and Claude W. Horton. **A Hydro-Acoustic Filter**. Patent. Washington, DC: Department of the Navy, May 1974. 6p.
ABSTRACT: The patent relates to a hydroacoustic filter of a character adapted to be used as a passive frequency selective network for feeding an acoustic pressure sensitive detector or the like. The filter along with the accompanying detector are each well adapted for use in combination, as a part of an acoustic wave detecting mechanism for naval mines.
REPORT NUMBER: PATENT: 3,812,456
http://www.uspto.gov/patft/

Lavely, Eugene. **Sensor Phenomenology and Feature Development for Improved Sonar-Based Detection & Classification of Underwater UXO**. Washington, DC: BAE Systems Inc., 2009. 233p.
ABSTRACT: This effort has examined the problem of detection and classification of buried munitions in underwater environments. We have focused on the use of low frequency sonar since high frequency acoustic waves are strongly attenuated by sediments. The focus of this effort has been to process low-frequency data collected from the Buried Object Scanning Sonar (BOSS) into 3D imagery using beamforming, and to develop target/clutter classifiers that use 3D features extracted from this imagery. The principal sonar data sources are BOSS deployments at various shallow water sites. Morphological processing was applied to the derived imagery for feature input into a relevance vector machine classifier. Since ground truth was available, it was possible to compute performance metrics in the form of ROC curves. To enable a systematic understanding of the influence of the environment on target responses, we have developed a poroelastic spectral element method for BOSS data simulations using 2D and 3D models. The classification results establish that buried targets have a high probability of detection with the Buried Object Scanning Sonar. However, features from target imagery responses are easily confused with those of clutter and munitions debris due to their incomplete separation. Small subsets of possible imagery features show the best performance, and various examples are shown. We provide a theoretical development for the estimation of structural acoustic resonance features from BOSS-like data. Future classification performance gains with the sonar modality will likely rely on the combined use of imagery- and resonance-based features.
ACCESSION NUMBER: ADA520643
http://handle.dtic.mil/100.2/ADA520643

Laxar, Kevin, et al. **Relative Effectiveness of Four Color Coding Techniques for Intensity Coding on Simulated Advanced Mine Detection System (AMDS) Displays**. Interim report. Groton, CT: Naval Submarine Medical Research Laboratory, 10 September 1993. 17p.
ABSTRACT: Four methods of color coding the intensity levels of sonar returns on the Advanced Mine Detection System displays, currently under development, were studied to determine how the added use of color could enhance operability. The target detection and identification performance of seven experienced observers was measured using the following schemes for coding signal intensity into eight discrete steps: levels of green (the original coding method), levels of white, colors approximating specifications supplied by the Naval Undersea Warfare Center (NUWC), and colors arranged according to lightness, from dark to light. A portion of a static AMDS display 726 pixels wide by 323 pixels high was simulated on a computer controlled color display system. A single target simulating six sonar pings, or histories, was six pixels wide (10.2 arc min visual angle) by one pixel high, and was present on 50% of the trials. It could be located anywhere in the background. Four target signal strengths were used. The randomized distributions of the background noise levels and the target levels were specified by NUWC and considered to be representative of those expected at sea. Each observer ran on two 100-trial sessions of each of the 16 conditions, combinations of one of the four target strengths and one of the four color coding schemes. In a signal detection paradigm, for each trial the

observer signalled, by key press, confidence in the presence or absence of a target on a four-point scale, and indicated the location of the target, when present, by means of a trackball cursor. The hit rates (percentage of trials Decision making, Tactical displays, Human subjects, Visual sonar displays, Performance.

ACCESSION NUMBER: ADA275196

http://handle.dtic.mil/100.2/ADA275196

Leadmon, John, Wesley Wilson, Louis Carl and David Woodward. **Submersible Combatant Concept for Improved Littoral Warfare.** Bethesda, MD: Naval Surface Warfare Center, Carderock Division, 2004. 25p.

ABSTRACT: The current proliferation of low cost, low technology means of access denial raises the cost of U.S. power projection in many areas of the world. This problem is especially evident in the littoral environment, where enemy forces may employ a host of access denial methods including submarines, mines, small boats, and undersea sensor systems. These regions also exhibit maneuvering and navigational challenges such as underwater obstacles and civilian shipping vessels. Future naval platforms will rely heavily on the use of unmanned vehicles to more effectively perform their missions. While it is possible to deploy, support, and retrieve many of these unmanned vehicles from a high- end platform (e.g., SSN, SSGN), it is proposed that there may be a more efficient and cost effective means of managing these smaller vehicles and payloads. The KAPPA submersible craft concept, the result of a Carderock Division Naval Surface Warfare Center (CDNSWC) Innovation Center project, may be an effective, cost efficient force multiplier that can perform covert missions in littoral regions and austere ports, assist in providing and maintaining access, and support other joint assets. The KAPPA craft concept is a stealthy, highly maneuverable craft, with a modular payload volume and flexible ocean interface that acts as part of a "cascading payloads" chain for improved littoral warfare operations.

ACCESSION NUMBER: ADA422093

http://handle.dtic.mil/100.2/ADA422093

Lemerande, Tobias J. **Transmitting Beam Patterns of the Atlantic Bottlenose Dolphin (Tursiops Truncatus): Investigations in the Existence and Use of High Frequency Components Found in Echolocation Signals.** Monterey, CA: Naval Postgraduate School, June 2002. 148p.

ABSTRACT: In January 2002, time synchronized underwater pictures and echolocation signals of a free-swimming bottlenose dolphin were recorded. More than 80 experimental trial runs were recorded at the Space and Naval Warfare Center's Marine Mammal Facility in San Diego, California. The apparatus recorded 30 underwater images per second and sonar signals up to 400 kHz. Data analysis shows wide transmitting beam patterns at frequencies lower than 135 kHz contain a majority of the energy in the echolocation signal, agreeing with previously documented work. However, further analysis shows significant energy at higher frequencies. Early in the experiment, the dolphin steered narrow high frequency signals and adjusted the energy content in those different frequencies while scanning the target. To emit these high frequency components, the dolphin changed the wave shape of the emitted sound pulse. As the experiment progressed, the animals task became routine and the high frequency signals were noticeably absent until low frequency noise was projected into the water, at which time the high frequencies were again present in the emitted sound pulses. Resultant transmitting beam patterns provide excellent evidence of the presence of high frequency sound emissions, and also indicate how these signals are used during echolocation tasks.

ACCESSION NUMBER: ADA406289

http://handle.dtic.mil/100.2/ADA406289

http://edocs.nps.edu/npspubs/scholarly/theses/2002/Jun/02Jun_Lemerande.pdf

Li, Pei-Chieh. **Planning the Optimal Transit for a Ship Through a Mapped Minefield.** Master's thesis. Monterey, CA: Naval Postgraduate School 2009.
ABSTRACT: This thesis develops (a) a mission-planning tool for a Navy Mine Counter Measure (MCM) force to find a minimum-risk route for a surface ship through a mapped minefield, and (b) a heuristic to identify a sequence of mines whose clearance (removal and/or deactivation) leads to a rapid reduction of the risk of a minimum-risk path. All modeling concepts reflect the requirements of the Republic of China Navy's MCM operations. The problem is formulated and solved as a shortest-path problem in a network. A grid of nodes, representing waypoints, is embedded in a representation of the operating area, while arcs are created to link waypoints. The risk function is defined in terms of the closest point of approach distance between each mine that falls within a maximum danger radius along a route. A complete planning tool is implemented using Excel and Visual Basic for Applications. A basic test scenario describes an operational area of 1,000 by 3,000 yards containing 30 mines; node spacing is 100 yards. The minimum-risk path is found in few seconds on a laptop computer, while a greedy "mine clearance list" is found in a few minutes.
ACCESSION NUMBER: ADA508985
http://handle.dtic.mil/100.2/ADA508985
http://edocs.nps.edu/npspubs/scholarly/theses/2009/Sep/09Sep_Li.pdf

Logistics Support Analysis Strategy, **Working Papers Remote Minehunting System (RMS).** Washington, DC: Naval Sea Systems Command, 1991. 67p.
ABSTRACT: Document is an initial, tailored implementation of the LSA and LSAR requirements for the RMS program.
ACCESSION NUMBER: ADA255807
http://handle.dtic.mil/100.2/ADA255807

Lohrenz, Maura, Michael Trenchard, and Stephanie Edwards. **On-Line Evaluation of Cockpit Moving-Map Displays to Enhance Situation Awareness in Anti-Submarine Warfare and Mine Countermeasures Operations**. Stennis Space Center, MS: Naval Research Laboratory, Marine Geosciences Division, 31 May 2001. 4p.
ABSTRACT: Cockpit moving-map systems have provided heightened situation awareness to the fighter pilot for more than ten years, but these systems have yet to be integrated into military helicopters. The Navy now plans to install a moving-map system into its new, multi-functional MH-60S helicopter, which will perform mine countermeasures (MCM), combat search and rescue, special operations, and logistics. Other H-60 variants (e.g., SH-60B) perform anti- submarine warfare (ASW), surface warfare, surface surveillance, and other missions. Naval Research Laboratory scientists were tasked to demonstrate and evaluate the potential of a cockpit moving-map for enhanced situation awareness during multi-functional helicopter missions (particularly MCM and ASW). This project consisted of three main tasks: (1) conduct a web-based survey of pilots and aircrew experienced in MCM and ASW for their preferences with respect to various environmental data that could be displayed in a moving-map; (2) demonstrate and evaluate pilot-preferred data on existing moving-map displays; and (3) recommend potential data types to be collected and displayed in a multi- mission helicopter.
REPORT NUMBER: NRL/PP/7440--01-1008
ACCESSION NUMBER: ADA393119
http://handle.dtic.mil/100.2/ADA393119

Long, Edwin T. **Manned Testing of Fullerton Sherwood SIVA 55-VSW Underwater Breathing Apparatus (UBA) for Very Shallow Water (VSW) Mine Countermeasure (MCM) Missions**. Panama City, FL: Navy Experimental Diving Unit, November 1999. 32p.

ABSTRACT: Presently, no specific diving apparatus on the Authorized for Navy Use (ANU) list meets the demands set forth by the CNO to conduct very shallow water mine countermeasure (VSW MCM) operations. NEDU was tasked to test and evaluate the Fullerton Sherwood SIVA 55-VSW Underwater Breathing Apparatus (UBA) , to determine whether it will maintain a sufficient O2 fraction to support a working diver from the surface to 60 fsw (10.4 msw). Using a 30% / 70% N2 / O2 mix, NSDU personnel conducted at least 16 SIVA 55 dives each in 77 deg +/- 3 deg F (25 deg +/- 1.7 deg C) water in the 15 ft. (4.6 mew) deep NSDU test pool, and at 40 and 60 few (12.2 and 18.4 mew) in the NEDU Ocean Simulation Facility (OSF). Divers conducted manufacturer-sanctioned UBA purges on the surface and an additional purge after reaching the bottom, rested five to 10 minutes, then pedaled on underwater ergometers for 30 minutes each at 50 and 75 watts. During test pool dives, nearly a quarter of the divers' UBAs reached potentially hypoxic levels. We conducted another set of test pool dives and determined that setting the "buoyancy control valve" (BCV) half-open-vice one-quarter open during the first series-ensured adequate UBA O2 concentrations. At 40 few nearly half of the divers' UBA PO2 remained above 1.3 ATA after 10 minutes of exercise (mean = 1.34 ATA; range = 1.09 - 1.45 ATA) but, for all but one diver, dropped below 1.3 ATA within 13 minutes. Average PD: during the initial 10 minute rest period was 1.41 ATA. At 60 few we halted testing after four dives due to high PO2 levels (mean = 1.63 ATA). Because the U.S. Navy Diving Manual authorizes divers' PO2 to reach 1.4 ATA without Commanding Officer (CO) authorization- and 1.6 ATA with CO authorization-we recommend that the SIVA 55-VSW be accepted and authorized for use by the VSW MCM detachment with the following caveats: (1) Never plan dives exceeding 40 few; (2) complete a thorough UBA purge prior to entering the water and before ascending.

REPORT NUMBER: NAVSEA-TA-020
ACCESSION NUMBER: ADA371261
http://handle.dtic.mil/100.2/ADA371261

Lu, Han-Chung. **Using Expert Systems in Mine Warfare**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1991. 90p.

ABSTRACT: Historically, sea mines warfare have played an important role in warfare, which a naval officer cannot afford to neglect. During the recent mine campaign in the Middle East involving Iran an Iraq, commanders delayed decisions on whether or not to deploy mine countermeasure (MCM) forces. As a result, damage occurred to ships in a minefield that could have been prevented by the speedy application of MCM. Before the operational mission commenced, there are several uncertain questions in the mind of the commander: Do the mine-fields exist. Which country laid the mines. What type of delivery platform laid the mines. Where are the mines. What kind of mines are they. Do we need to deploy the MCM forces. Previously, these kinds of fuzzy questions were very difficult to answer by a tactical principle. In this thesis, the probabilistic inference network in the expert system environment is used to answer the above questions. The probabilistic inference network method is supported by the certainty factors. Calculations involving quantitative probabilities for answers to the above questions could enable the MCM experts to offer suggestions to the commander for reducing the ship's vulnerability at sea during wartime.

ACCESSION NUMBER: ADA247758
http://handle.dtic.mil/100.2/ADA247758

Ludlum, Bobby R. **A Balanced Active Antenna and Impulse Noise Blanker System for the Raydist T Radio Navigation Receiver**. Panama City, FL: Naval Coastal Systems Center, February 1982. 32p.
ABSTRACT: Erratic operation of Raydist T radio navigation equipment aboard mine countermeasures helicopters has been traced to fuselage-tow cable interactions with the Raydist receiving antenna and to negative-corona generated impulse noise. The development of a balanced active antenna and an impulse noise blanker which have proved successful in reducing these detrimental effects are described. The final system is described in detail and the results of laboratory tests are presented.
REPORT NUMBER: NCSC-TM-340-82
ACCESSION NUMBER: ADA114074

Machado Guedes, Mauricio J. **Minefield Reconnaissance Simulation**. Monterey, CA: Naval Postgraduate School, June 2002. 60p.
ABSTRACT: The Navy plans to do covert reconnaissance of minefields with a remote underwater vehicle that includes two sensors, one long-range (LR) and one short-range (SR). LR can detect mines, but it cannot distinguish them from harmless mine-like objects. SR can tell the difference, but only by approaching to within short range. A program called MIRES (Minefield Reconnaissance Simulator) is implemented to answer the questions of how the vehicle should perform a search and to estimate the number of mines remaining in the area once the reconnaissance is over. MIRES investigates four modes of search; a planned search with departure to identify an object, a planned search with no departure, and two kinds of random search. It compares these types of search and identifies the best search mode for a given scenario.
ACCESSION NUMBER: ADA404616
http://handle.dtic.mil/100.2/ADA404616
http://edocs.nps.edu/npspubs/scholarly/theses/2002/Jun/02Jun_Guedes.pdf

Mansell, T.M., D.R. Skinner, and K.K. Benke. **Application of Artificial Intelligence in Decision Making in Mine Countermeasures**. Canberra (Australia): Defence Science and Technology Organisation, December 1995. 59p.
ABSTRACT: A number of analytic techniques used in Artificial Intelligence are examined in the context of decision making in mine countermeasures. Attention is directed at five major techniques, involving statistical inference, probabilistic inference, evidential reasoning, fuzzy logic and artificial neural networks. In the cases of statistical inference and evidential reasoning, solutions to appropriate problems are described. Eleven other techniques are dealt with more briefly, in most cases with worked examples of appropriate naval application. The main conclusion reached is that, in view of the probable shortage of accurate information under operational conditions, evidential reasoning and fuzzy logic are likely to be the most appropriate means for presenting relevant data to decision makers, and that artificial neural networks will be useful for representing complicated or empirical relationships between observed factors.
REPORT NUMBER: DSTO-TR-0279
ACCESSION NUMBER: ADA307260
http://handle.dtic.mil/100.2/ADA307260

Marco, David B. **Autonomous Control of Underwater Vehicles and Local Area Maneuvering**. Monterey, CA: Naval Postgraduate School, September 1996. 359p.

ABSTRACT: The major thrust of this work is the development and demonstration of new capabilities for the use of small autonomous vehicles in mine countermeasure applications. Key to the new capabilities lies in an open architecture tri-level software structure for hybrid control, of which this work is the first validated implementation. The two upper levels run asynchronously in computing logical operations based on numerical decision making, while the lowest, the Execution Level, runs synchronously to maintain stability of vehicle motion. The top (Strategic) Level of control uses Prolog as a rule based language for the specification of the discrete event system (DES) aspects of the mission. Multiple servo controllers are coordinated by the middle (Tactical) Level software in performing the mission, while the Execution Level controllers guarantee robust motion stability through multiple sliding modes.

ACCESSION NUMBER: ADA322339

http://handle.dtic.mil/100.2/ADA322339

http://edocs.nps.edu/npspubs/scholarly/theses/96Sep_Marco.PhD.pdf

Martin, P., et al. **Proceedings of the Ship Control Systems Symposium (5th)**, **Held at U. S. Naval Academy**, **Annapolis**, **Maryland on October 30 - November 3**, **1978.** Volume 2. Annapolis, MD: David W. Taylor Naval Ship Research and Development Center, 3 November 1978. 349p. [See also Volume 3, **ADA159083**]

ABSTRACT: Partial contents: Ship Handling Simulator; Ship Control Centre Training Facilities for the Royal Navy; Ship Maneuverability Transducer Controlled by Mini-Computer for Training Ship - Onboard ship handling simulator; Modern Control Theory for Dynamic Positioning of Vessels; Design and Simulation of Navigation and Ship Control Algorithms for a Minesweeper; Automatic and Manual Control of the 'Tripartite' Minehunter in the Hover and Track Keeping Modes - a Preliminary design; Reversing Dynamics of a Gas Turbine Ship with Controllable-Pitch Propeller; Transient Behavior of Gasturbo-electric and Fixed Pitch Propeller; Gas-Turbine Simulation Techniques for Ship Propulsion Dynamics and Control Studies; New Ship Technical Control Systems for the Royal Norwegian Navy; Development of a Machinery Control and Surveillance System for a Mine Countermeasures Vessel; Developments in Marine Gas Turbine Condition Monitoring Systems; Optimal Control of Hydrofoil Ship Lateral Dynamics; Future Propulsion Control System Functional Requirements; and High Power Superconducting Ship Propulsion System - Its control functions and possible control schemes.

ACCESSION NUMBER: ADA159082

Mason, Russell I. **Harbor Approach-Defense Embedded System.** Patent. Washington, DC: Department of the Navy, filed 27 June 1991, patented 11 August 1992. 10p.

ABSTRACT: Acoustically mapping (fingerprinting) the main channel, or 'Q' routes, of a harbor, over relatively long time periods by using transducers anchored near the harbor or Q route floor. Sonar pulse returns are processed so that echoes from acoustic targets are constantly monitored and integrated over long periods of time. The integrated sonar data are used to establish a characteristic bottom-image map for the presence and location of permanent objects such as debris, underwater formations and the like. The long term, integrated record is obtained to establish a reliable acoustic fingerprint or reference mapping of the bottom. This acoustical record or map, which is quite stable over long periods of time, is used to compare newly detected acoustic variances from the established map. A combination of active and passive acoustic sensors that are installed at fixed positions submerged in the channel permit the determination of both range and bearing when an intruding object has been detected.

REPORT NUMBER: PATENT: 5,138,587
http://www.uspto.gov/patft/

Matika, Dario and Vladimir Koroman. **Undersea Detection of Sea Mines**. Zagreb Croatia: Ministry of Defence, 2001. 16p.
ABSTRACT: *In this paper the authors tried to analyse the features of possible undersea threats, such as sea mines, available countermeasures and other activities. Detection, approach, inspection and destruction of an unidentified sunken object by a remotely operated underwater vehicle (ROV) is described. The authors tried to define ROV control parameters and optimisation criteria. ROV control simulation model is developed and tested with two different dynamic positioning algorithms. The paper includes results of ROV manoeuvres simulation. According to these results, the authors conclude that the use of ROVs in undersea detection and destruction of sea mines and other hazardous objects is an effective and efficient solution.*
ACCESSION NUMBER: ADP013405
http://handle.dtic.mil/100.2/ADP013405

Maxwell, Tim A. **An Evaluation of the Hydra-7 Countermine Weapon System**. Monterey, CA: Naval Postgraduate School, June 2000. 91p.
*ABSTRACT: The basic principle of Maneuver Warfare in the 21st century is the seamless integration of sea and land as maneuver space. Unfortunately, our inability to conduct **countermine** and counterobstacle operations in the littorals severely curtails our ability to conduct Amphibious Warfare, a key ingredient to maneuver. Hydra-7, a possible solution to this problem, is one of the most promising **countermine** weapons under development, but its final performance level will depend on the effectiveness of subcomponent technologies. These subcomponent technologies have yet to reach maturity and may not perform as well as desired. This thesis provides analysis procedures and models to predict Hydra-7 effectiveness for a broad range of possible performance values of subcomponent systems. The methodology will determine which of the subcomponent technologies is most critical to the final performance of Hydra-7.*
ACCESSION NUMBER: ADA381684
http://handle.dtic.mil/100.2/ADA381684
http://edocs.nps.edu/npspubs/scholarly/theses/00Jun_Maxwell.pdf

McClelland, Scott C. **A Rolling Line Source for a Seismic Sonar**. Monterey, CA: Naval Postgraduate School, June 2002. 84p.
ABSTRACT: This thesis builds on ideas of a seismo-acoustic sonar as a mine detection tool and is part of an ongoing Naval Postgraduate School (NPS) research project. Building on this foundation of research, a source was developed to enable mobility. The previous NPS array Sheetz design employed an array of sources, buried in the sediment in a line. This arrangement is somewhat cumbersome for direct application. A practical device should be mobile and create a high source signal similar to the previous NPS array. A rolling cylinder provided the solution. The cylinder houses two shakers, identical to the previous NPS array elements, mounted directly to the cylinder wall. The source for a single buried array element, from the previous NPS array, and a single rolling cylinder, placed on the surface, were shown to provide similar seismic velocity at ten meters range.
ACCESSION NUMBER: ADA405961
http://handle.dtic.mil/100.2/ADA405961
http://edocs.nps.edu/npspubs/scholarly/theses/2002/Jun/02Jun_McClelland.pdf

McFee, J. E. and Y. Das. **Advances in the Location and Identification of Hidden Explosive Munitions.** Ralston (Alberta): Defence Research Establishment Suffield, February 1991. 96p.
ABSTRACT: *No abstract available.*
ACCESSION NUMBER: ADA233665
http://handle.dtic.mil/100.2/ADA233665

McGinlay, Thomas Charles John. **Personnel and Equipment Design Concept for a Maritime Patrol Airship (Non-Rigid) to Conduct Search**, **Anti-Submarine Warfare**, **and Airborne Mine Countermeasures Missions**. Monterey, CA: Naval Postgraduate School, December 1979. 227p.
ABSTRACT: A personnel and equipment design concept for a non-rigid, 100 hour endurance, Maritime Patrol Airship meeting Search and Rescue (SAR), Anti-Submarine Warfare (ASW), and Airborne Mine Countermeasures (AMCM) requirements was developed. The Maritime Patrol Airship could readily be equipped with off-the-shelf equipment. Minimal new design equipment requirements were identified. A baseline flight scenario and on station scenarios for: SAR, transoceanic ASW utilizing a passive towed array sonar, and AMCM were developed. Human factors task analyses and a time line analysis were constructed from the scenarios. Manning reductions resulted for each scenario (3 crewmembers for SAR, 10 crewmembers for transoceanic ASW, 7 crewmembers for AMCM). Further research areas are identified.
ACCESSION NUMBER: ADA085144

McIntyre, Trevor A. **Ultrasonic Acoustic Characteristics of Air Bubbles in the Surf Zone**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1995. 119p.
ABSTRACT: Understanding the movement of sediment in the nearshore region due to wave motion and longshore currents is important in beach erosion studies, and has tactical significance in beach front mine warfare. Using ultrasonic acoustic backscatter, the Coherent Acoustic Sediment Flux Probe (CASP) is capable of tracking the movement of scatterers within the surf zone. Laboratory experiments were run to determine the ultrasonic acoustic backscatter characteristics of surf zone bubbles. Bulk void fraction and optical sizing methods were explored to develop a means of measuring bubble populations produced in the laboratory for calibration of the backscattered energy received by the CASP system in the presence of bubbles.
ACCESSION NUMBER: ADA305430
http://handle.dtic.mil/100.2/ADA305430
http://edocs.nps.edu/npspubs/scholarly/theses/95Sep_McIntyre.pdf

McKeehan, L.W. **Preliminary Report on Collection of Scientific Data**. New Haven, CT: Yale University, 14 March 1952. 37p.
ABSTRACT: Operation MUD was suggested by the Office of Naval Research early in October, 1951, as a cooperative research project to provide the mine countermeasures program of the Navy with additional basic data concerning the physical behavior of ground mines and the environmental conditions affecting their spotting and location. This is a report on this operation.
ACCESSION NUMBER: AD0896041

McKeehan, Louis W., John S. Coleman and J. P. Maxfield. **Harbor Defense Against Mining and a Proposed Mine Locator System**. Washington, DC: National Academy of Sciences, National Research Council, Committee on Undersea Warfare, May 1951.
ABSTRACT: None Available.
ACCESSION NUMBER: AD103753

McKinney, C. **International Symposium on Mine Warfare Vessels and Systems Held at London**, **England on 12-15 June 1984**. Conference report. London (England): Office of Naval Research, 19 July 1984. 15p.
ABSTRACT: The International Symposium on Mine Warfare Vessels and Systems was held in London from 12 through 15 June 1984. This report discusses presentations on platforms and propulsion equipment for mine countermeasures systems, and minehunting systems and components.
ACCESSION NUMBER: ADA146408

Middlebrook, Edwin E. **A Combat Simulation Analysis of Autonomous Legged Underwater Vehicles**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1996. 83p.
ABSTRACT: Autonomous Legged Underwater Vehicles (ALUVs) are inexpensive crab- like robotic prototypes which will systematically hunt and neutralize mines en masse in the very shallow water and the surf zone (VSW/SZ). With the advent of mine proliferation and the focal shift of military power to the littorals of the world, ALUVs have the potential to fill a critical need of the United States Navy and Marine Corps mine countermeasure (MCM) forces. Duplicating the MCM portion of the Kernel Blitz 95 exercise whenever feasible, this thesis uses the Janus interactive combat wargaming simulation to model and evaluate the effectiveness of the ALUV as a MCM. Three scenarios were developed: an amphibious landing through a minefield using no clearing/breaching; an amphibious landing through a minefield using current clearing(breaching techniques; and an amphibious landing through a minefield using ALUVs as the clearing(breaching method. This thesis compares the three scenarios using landing force kills, cost analysis, combat power ashore, and percentage of mines neutralized as measures of effectiveness.
ACCESSION NUMBER: ADA314862
http://handle.dtic.mil/100.2/ADA314862

Middlebrook, Edwin E., Bard K. Mansager, and Carlos F. Borges. **Combat Simulation Analysis of Autonomous Legged Underwater Vehicles**. Monterey, CA: Naval Postgraduate School, Department of Mathematics. September 1997. 15p.
ABSTRACT: Autonomous Legged Underwater Vehicles (ALUVs) are inexpensive crab-like robotic prototypes which will systematically hunt and neutralize mines en masse in the very shallow water and the surf zone (VSW/SZ). ALUVs have the potential to fill a critical need of the United States Navy and Marine Corps mine countermeasure (MCM) forces. Duplicating the MCM portion of the Kernel Blitz 95 exercise whenever feasible, this thesis uses the Janus interactive combat wargaming simulation to model and evaluate the effectiveness of the ALUV as a MCM. Three scenarios were developed: an amphibious landing through a minefield using no clearing/breaching; an amphibious landing through a minefield using current clearing/breaching techniques; and an amphibious landing through a minefield using ALUVs as the clearing/breaching method. This thesis compares the three scenarios using landing force kills, cost analysis, and combat power ashore as measures of effectiveness.
REPORT NUMBER: NPS-MA-97-006

ACCESSION NUMBER: ADA335557
http://handle.dtic.mil/100.2/ADA335557
http://edocs.nps.edu/npspubs/scholarly/theses/NPS-MA-97-006.pdf

Molenda, Patrick A. **Organic Mine Countermeasures: An Operational Commander's Key to Unlocking the Littorals**. Newport, RI: Naval War College, Joint Military Operations Department, 5 February 2001. 27p.
ABSTRACT: This paper examines the U.S. Navy's organic mine countermeasure (MCM) concept as it pertains to the operational commander. The U.S. Navy is embarking on a MCM concept that will rely heavily on organic countermine systems tied directly to surface warships, helicopters and submarines. While organic MCM assets will offer some advantages, a close examination of the concept identifies many operational shortcomings. Specifically, the organic MCM concept will do little to assure littoral access for naval and land forces through a mined environment. The Navy hopes that as organic MCM systems mature, the need for dedicated MCM forces will decrease. This will facilitate an 'in-stride' capability for an operational commander to maneuver through mined seas. This paper shows that because of the complexity of the modern naval mine threat and the operational limitations of organic MCM deployment, a substantial dedicated MCM force will still be required to ensure maximum effectiveness in a mined operating area. Despite the sophistication of new MCM technology, mine warfare will remain a slow, tedious, and challenging discipline. Only through a prudent mix of organic and dedicated MCM forces will an operational commander be able to prevail against the formidable naval mine threat.
ACCESSION NUMBER: ADA389665
http://handle.dtic.mil/100.2/ADA389665

Morgan, K.R. and M. Fennewald. **Unmanned Testing of Fullerton Sherwood SIVA VSW Underwater Breathing Apparatus (UBA) for Very Shallow Water (VSW) Mine Countermeasure (MCM) Mission**. Panama City, FL: Navy Experimental Diving Unit, October 1999. 20p.
ABSTRACT: In response to the continuing challenge of conducting MCM in depths between 10 to 40 fsw, the CNO has authorized the Near Term Mine Warfare Campaign Plan. This plan includes the establishment of the VSW MCM Detachment as a primary supporting unit. Presently, no specific diving apparatus on the ANU list meets the demands set forth by CNO to conduct VSW MCM operations. NEDU has been tasked to test and evaluate the Fullerton Sherwood SIVA VSW UBA to determine if it meets the stringent requirements for operating in this mission area. NAVSEA Diving Safety Certification requirements must be met to achieve the designation of 'Authorized for Navy Use' set forth by NAVSEA 00C prior to fielding any UBA in the U.S. Navy. This report deals with the conduct of unmanned diving tests and procedures to verify functional characteristics in accordance with manufacturer's specifications and the VSW MCM UBA Performance Specification.
ACCESSION NUMBER: ADA371173
http://handle.dtic.mil/100.2/ADA371173

Mulhearn, P.J. **Mathematical Model for Mine Burial By Mobile Underwater Sand Dunes.** Canberra (Australia): Defence Science and Technology Organisation, March 2002. 31p.
ABSTRACT: An important parameter for the prediction of mine burial on impact, when a mine is first laid, is the sediment bearing strength profile. A number of nations have been developing easily deployable penetrometers for measuring bearing strength relatively quickly. The plan would be to use these in route survey operations. Previous joint experiments by TTCP (The Technical Coperation Program) nations have found that the measured bearing strength decreases as the

diameter of a penetrometer increases. This effect is not currently understood, but in this report it is shown, with the help of some new experiments, that with the right penetrometer design it is possible to obtain bearing strength profiles which can be validly used for mine burial prediction. Finally a particular penetrometer configuration is recommended for navy use.

REPORT NUMBER: DSTO-TR-1285
ACCESSION NUMBER: ADA402610
http://handle.dtic.mil/100.2/ADA402610

Mulhearn, P.J. **Mathematical Model for Mine Burial By Mobile Underwater Sand Dunes.** Canberra (Australia): Defence Science and Technology Organisation, January 1996. 28p.

ABSTRACT: Buried mines in the approaches to major ports and in shipping choke points constitute a significant problem in mine countermeasures operations because they are so hard to detect. One of the burial mechanisms which occurs in some important locations is burial by mobile underwater sand dunes (also called sand waves). In this report, a new mathematical model is presented for this process and it is shown that the factors which are most critical for the time taken for a mine to become buried are current strength, dune size, and the initial location of a mine in relation to crests and troughs of a sand dune field. As current strength increases, the time taken for a mine to become buried decreases sharply. The time until burial increases as a dune's size increases and as a mine's initial distance downstream from a dune's crest increases.

REPORT NUMBER: DSTO-TR-0290
ACCESSION NUMBER: ADA307307
http://handle.dtic.mil/100.2/ADA307307

Mulhearn, P. J., et al. **Short Range Lateral Variability of Seabed Properties (With Some Notes on Larger Scale Features) Near Port Hedland**, **WA.** Canberra, Australia: Defence Science and Technology Organisation, Aeronautical and Maritime Research Laboratory, 1996. 28p.

ABSTRACT: The spatial variability of seabed sediment properties over short ranges is investigated, and it is found that, at least for sands, sediment grain size varies within a factor of square root of 2 over distances of order 100 m. Evidence is then presented that this sediment variability, found off Port Hedland, is similar to that at many other locations around the world. Hence for acoustic backscatter and mine burial models the conventional categories: very coarse, coarse, medium, fine and very fine, for sands are as precise as it is practical to be. This implies that survey methods, with, for example, acoustic sea floor classification systems, need only provide sediment grain size to this level of accuracy. It also means that, for mine-counter measures purposes, conventional survey methods can be relatively simple, and that many existing data bases are quite adequate. From underwater video footage it is clear that many important seabed features, such as shell beds, branching corals and seaweed clumps, can easily be overlooked in sea floor surveys, with either grabs or corers alone, and that this, at times, would lead to misleading conclusions concerning environmental factors relevant to mine warfare operations. A number of interesting seabed features have been observed near Port Hedland using a sub-bottom profiler and diver-operated underwater video cameras. Because so little is known in this area, it was thought these observations were worth recording, as an appendix to this report. In particular video-camera observations of some of the long, linear, underwater ridges off Port Hedland established them to be rocky reefs, rather than sand bars, as was previously thought. This changes previous perceptions of likely mine burial mechanisms off a number of Northwest Shelf ports.

REPORT NUMBER: DSTO-TN-0022; NIPS-97-12242
ACCESSION NUMBER: ADA315399
http://handle.dtic.mil/100.2/ADA315399

Mulhearn, P.J. **Turbidity in Torres Strait**. Adelaide (Australia): Weapons Systems Research Laboratory, July 1989. 40p.
ABSTRACT: The turbidity in the eastern half of Torres Strait, along with other relevant variables, was investigated in two oceanographic cruises in early 1988. Turbidity was high and variable and a regression equation has been developed relating Secchi disc depth (and thence underwater visibility range) to water depth and wind speed. This equation covered 71% of the rms variation in Secchi disc depth. Turbidity was approximately constant with depth in weakly stratified waters, except when they were particularly turbid (attenuation coefficient > 1.0/m) and then turbidity generally increased with depth with, in some cases, maxima or minima occurring within the water column. Where the temperature and salinity varied markedly with depth a more turbid lower layer was also present. On the second cruise there was a significant correlation between salinity and turbidity in the central waters of eastern Torres strait which had low salinity, and the possible origin of this low salinity water body is discussed.
REPORT NUMBER: WSRL-TM-35/89
ACCESSION NUMBER: ADA223447
http://handle.dtic.mil/100.2/ADA223447

Murphree, Francis J., Henry L. Warner and Edward G. McLeroy, Jr. **Marine Mine Detector**. Patent. Washington, DC: Department of the Navy, March 1976.
ABSTRACT: The patent relates to a sonar system for detecting and identifying objects lying on or submerged in a sea floor. The system has a dual frequency transmitter and a dual frequency receiver for timely broadcasting and receiving a pair of relatively high and low frequency acoustical signals, respectively, in accordance with a predetermined timing program which facilitates the display and interpretation thereof.
REPORT NUMBER: PATENT: 3,943,482
http://www.uspto.gov/patft/

Naval Surface Warfare Center Dahlgren Division. Technical Digest. Ship Defense Technology. Dahlgren, VA: Naval Surface Warfare Center, Dahlgren Division, September 1994. 155p.
ABSTRACT: CONTENTS - Guest Editor's Introduction: Towards A Proactive Surface Force-The Role of Ship Defense in the 21st Century; Short-Range Antiair Warfare Missile Systems Engineering; Integrated Interior Communications and Control-Engineering Validation of a Total Ship Architecture; Tactical Ballistic Missiles Trajectory State and Error Covariance Propagation; Superconducting Magnetic Sensors for Mine Countermeasures; Managing the Dynamics of the Electromagnetic Environment to Maximize Combat System Performance Electronic Warfare in Ship Defense Signal Simulators Used in Deception Nonlinear Least-Squares Estimation in Naval Gun Fire Control Robust Flight Control for Surface-Launched Tactical Missiles Water Barrier Ship Self-Defense Concept.
ACCESSION NUMBER: ADA294929
http://handle.dtic.mil/100.2/ADA294929

Naval Surface Warfare Center, **Dahlgren Division**, **Technical Digest**, 1998 Issue. Dahlgren, VA: Naval Surface Warfare Center, Dahlgren Division 1998. 179p.
ABSTRACT: This technical digest contains the following sections: (1) VLSTRACK, (2) mine countermeasures simulator, (3) advanced technology for MIW training, (4) FATEPEN, a model to evaluate behavior of warhead fragments and penetrators, and their damaging effects on military targets, (5) remote detection of chemical warfare agents, (6) the development and application of the shipboard collective protection system, (7) magic lantern deployment contingency, (8) remote mine hunting system, (9) diver portable sonar, (10) assault breaching operations, (11)

radiofrequency coupling characteristics of avionics measured on a passenger aircraft and in a reverberation chamber, and (12) NAVSTAR GPS.
REPORT NUMBER: NSWCDD-MP-98/98
ACCESSION NUMBER: ADA357068
http://handle.dtic.mil/100.2/ADA357068

Neto, Rodrigues and Jose Augusto. **Mine Search Algorithm for the Naval Postgraduate School Autonomous Underwater Vehicle.** Master's thesis. Monterey, CA: Naval Postgraduate School, December 1994. 102p.
ABSTRACT: This thesis develops, implements and tests a mine search algorithm for the Naval Postgraduate School Autonomous Underwater Vehicle (Phoenix). The vehicle is 72 inches long and displaces 400 pounds. Its maneuvers are performed using two propellers and four thrusters. It contains two embedded computer systems. The algorithm directs the autonomous search of a specified area mapping all obstacles and computing an estimate of the cumulative probability of detection. The algorithm uses no prior knowledge of the terrain or the location of mines. The algorithm, which is written in Lisp, can execute on the vehicle's computer systems. Along with the search and mapping capabilities, the algorithm executes obstacle avoidance. The algorithm is tested in several simulated scenarios with different placement of mines and obstacles; the amount of resources used and the fraction of the area searched is computed. A similar algorithm that uses hill-climbing search is implemented for comparison. In all cases, the newly developed algorithm performed equal or better than the one that uses hill-climbing.
ACCESSION NUMBER: ADA290024
http://handle.dtic.mil/100.2/ADA290024
http://edocs.nps.edu/npspubs/scholarly/theses/94Dec_Neto.pdf

O'Brien, Maeve. **Electromagnetic Detection of Water Mines Submerged in Seawater or Buried on Sandy Beaches.** Master's thesis. Las Vegas, NV: University of Nevada, Reno, 2002. 79p.

O'Rourke, Jack Redpath. **Decision Support Model for Evaluating MK16 Mine Countermeasure System Readiness Improvements**. Monterey, CA: Naval Postgraduate School, December 1997. 74p.
ABSTRACT: We have developed a decision support model to evaluate potential alternatives for improving MK 16 Mine Countermeasure (MCM) system mission readiness. Explosive ordnance disposal (EOD) resource managers are expected to maximize readiness in the face of increasing operational commitments and declining budgets. In order to remain effective in this environment, managers must take a more aggressive approach toward cost efficiency. This can be accomplished by reducing the potential variability associated with resource allocation decisions. We find we can reduce uncertainty through the use of decision support models and the application of sensitivity analysis. We will apply our model to reduce the uncertainty associated with the alternatives for improving MK 16 MCM system mission readiness.
ACCESSION NUMBER: ADA341828
http://handle.dtic.mil/100.2/ADA341828

Pearman, Gerald M. **Comparison Study of Janus and JLINK**. Master's Thesis. Monterey, CA: Naval Postgraduate School, June 1997. 139p.
ABSTRACT: The Janus simulation model was initially designed to operate in a stand-alone mode. There is an ongoing research project to link Janus to other constructive simulations and virtual simulators. The present standard used to connect different models is Distributed Interactive Simulation (DIS). Janus can operate in a DIS environment using a cell adapter unit called the World Modeler. The combination of Janus and the World Modeler is known as JLink. A

goal of the JLink system is to replicate the analytical and training fidelity of stand-alone Janus in a distributed exercise. The purpose of this thesis is to assess the current state of JLink development. The experiment simulated three scenarios: armored, armored coalition, and light infantry battalions attacking against a defending company. All scenarios were executed in two contrasting environments. The simulation included the recently developed JLink features Family of Scatterable Mine (FASCAM) and chemical artillery. The thesis used five Measures of Performance to base the assessment: (1) FASCAM kills, (2) Chemical Artillery Kills, (3) Detection Ranges, (4) Kill Ranges, and (5) Loss Exchange Ratio. The statistical tests used for analysis were the Analysis of Variance (ANOVA) test, two-sample t-test, and Wilcoxon test. The results of the analysis show that JLink requires adjustments to artillery delivery methods in order to correct chemical artillery discrepancies and detection range issues. In general, JLink accurately portrays coalition warfare and satisfactorily replicates armored and infantry scenarios in contrasting environments.

ACCESSION NUMBER: ADA333412

http://handle.dtic.mil/100.2/ADA333412

Perry, Stuart William. **Applications of Image Processing to Mine Warfare Sonar**. Melbourne, Victoria: Defence Science & Technology Organisation, Maritime Operations Division, Aeronautical and Maritime Research Laboratory, 2000. 20p.

ABSTRACT: It is the intention of the author that this report serve as a strategic review of the potential for image processing techniques to aid the detection and classification of underwater mines and mine-like objects in various modes of sonar imagery. Image processing techniques to improve the performance of mine hunting operations using sector-scan, side-scan and the Acoustic Mine Imaging (AMI) project imagery are considered. Four basic components of any Computer-Aided Detection and Classification (CADCAC) technique are considered, namely, enhancement, segmentation, computer-aided detection, and computer-aided classification. In each of these fields, image processing techniques from the literature are examined and possible extensions or alternatives are discussed.

REPORT NUMBER: DSTO-GD-0237

http://www.dsto.defence.gov.au/publications/2255/DSTO-GD-0237.pdf

Phaneuf, Matthew D. **Experiments with the REMUS AUV**. Master's Thesis. Monterey, CA: Naval Postgraduate School, June 2004. 77p.

ABSTRACT: This thesis centers on actual field operations and post-mission analysis of data acquired using a REMUS AUV operated by the Naval Postgraduate School center for Autonomous Underwater Vehicle Research. It was one of many platforms that were utilized for data collection during AOSN II, (Autonomous Oceanographic Sampling Network II), an ONR sponsored exercise for dynamic oceanographic data taking and model based analysis using adaptive sampling. The vehicle's ability to collect oceanographic data consisting of conductivity, temperature, and salinity during this experiment is assessed and problem areas investigated. Of particular interest are the temperature and salinity profiles measured from long transect runs of 18 Km. length into the southern parts of Monterey Bay. Experimentation with the REMUS as a mine detection asset was also performed. The design and development of the mine hunting experiment is discussed as well as its results and their analysis. Of particular interest in this portion of the work is the issue relating to repeatability and precision of contact localization, obtained from vehicle position and sidescan sonar measurements.

ACCESSION NUMBER: ADA424586

http://handle.dtic.mil/100.2/ADA424586

http://edocs.nps.edu/npspubs/scholarly/theses/2004/Jun/04Jun_Phaneuf.pdf

Poeckert, R.H. **Seabed Objects Size Distribution**. Dartmouth (Nova Scotia): Defence Research Establishment Atlantic, 1997. 16p.

ABSTRACT: The Canadian Navy is developing a route survey/mine hunting capability based on towed sidescan sonar. The sonar provides route survey data, essentially a detailed map of the seabed. Such data are used to determine whether objects detected during a mine hunting mission are new (not in the route survey database) and therefore could possibly be mines. In this report, the size distribution of mine-sized clutter on a section of seabed is examined and the effect of size estimation error on the utility of a route survey object database is explored. A mosaic of sidescan sonar images of a two kilometer square area of the Juan de Fuca Strait was scanned for objects greater than 0.5 meter in diameter. The size distribution analysis is presented and implications are discussed for mine detection in cluttered seabeds.

ACCESSION NUMBER: MIC98-04580

Potts, Malcolm H. **Don't Forget About Dedicated Sea Mine Countermeasures**. Norfolk, VA: Joint Forces Staff College, Joint Advanced Warfighting School, 2005. 80p.

ABSTRACT: America's reliance on the seas cannot be overstated. The U.S. depends upon the ocean as both the highway for force deployment and as the medium for global economic security. Free access to the waterways of the world determine the United States' ability to survive and prosper. The threat and the employment of sea mines are capable of interrupting the U.S. quest for national and economic security. Struggling through the Korean Conflict, the U.S. Navy began a slow improvement of MCM forces leading up to the first Gulf War where experiences led to the conclusion that a well equipped dedicated MCM force structure is essential. In the decade which followed, the Navy nurtured a dedicated MCM force that was capable of fully supporting COCOM requirements and combat proven in OIF. Ironically, prior to OIF, the U.S. Navy began to consider a future plan that features the substitution of proven, dedicated MCM forces with technology-leveraged OMCM forces. This move could leave the COCOM/JFC with a vulnerability gap that would be created by the divesting of dedicated forces prior to OMCM platforms being capable of conducting the mission. Specifically, the U.S. Navy planned organic MCM force has three weaknesses: even with advanced technology the inventory is too small, the reliance on favorable risk and intelligence analysis results is too great, and the heavy reliance on sealift for deployment is not supported by future MCM force structure. To prevent the vulnerability gap and cover the weakness, the U.S. Navy should field a robust dedicated MCM force beyond the currently planned timeline to ensure the successful mission completion of the COCOM/JFC.

ACCESSION NUMBER: ADA436558

http://handle.dtic.mil/100.2/ADA436558

Precision Control and Maneuvering of the Phoenix Autonomous Underwater Vehicle for Entering a Recovery Tube; Appendix (Video Recording). Monterey, CA: Naval Postgraduate School, Department of Computer Science, September 1996. 1p. Includes **ADA286932**.

ABSTRACT: Physical description: 1 VHS video; 1/2 in.; col.; sd.; standard playback sp.; 25 mins. This video appendix to the M. S. in computer science titled: Precision Control and Maneuvering of the Phoenix Autonomous Underwater Vehicle for Entering a Recover Tube by Duane Davis, contains several parts. The first part which shows the computer screen during the modeling process is illegible but represents a very small portion of the video. The rest of video shows the physical model in a water tank responding to the commands of the computer.

ACCESSION NUMBER: ADM000768

Preston, J. M. **Coordinates as Determined by Side-Scan Sonar: Theory and Applications.** Victoria (British Columbia): Defence Research Establishment Pacific, c1988. 48p.
ABSTRACT: A central issue in minehunting is the accuracy with which the coordinates of a mine-like object can be determined. This survey process is done in stages, first locating the ship, then locating the object with respect to the sonar, then determining the vector between the ship and the towfish if side-scan sonar is used. This report derives the equations which determine the chart coordinates of a bottom object from the 14 variables describing the side-scan sonar deployment which imaged that object. Improvements in the accuracy of the coordinates which could be achieved by improving the accuracy with which any variable is measured are then predicted. Coordinate data acquired during MINEX 87 is used to calculate the unmeasured angular variables which characterized that deployment.
REPORT NUMBER: DREP technical memorandum no. 88-02
ACCESSION NUMBER: MIC-91-0014

Pritchett, Clark W. **PATROL. Volume 1. Model Description and Analyst's Guide**. Groton, CT: Coast Guard Research and Development Center, September 1986. 70p.
ABSTRACT: A mathematical model of a Coast Guard cutter on a law enforcement patrol is described in this report. The kernel of the model is a Markov process that uses the phases of the patrol, such as search or transit, as states of the system. The phases of the patrol are separated by events, such as a detection which terminates a search and potentially initiates the pursuit of a vessel. A computer program called PATROL implements the model described here. The information that describes the law enforcement patrol is organized into four categories: Cutter, Traffic, Area, and Choices. Model outputs are grouped under three headings: Allocation of Effort, Vessel Performance, and Logistics. Distance, time, and fuel consumption information for every component of the patrol can be printed out at the option of the user. PATROL has a range of potential uses. These include vessel assessment, scenario development, accessing policy, strategy and tactics, and understanding the interrelationships of the different parts of the patrol problem. The appendices of this report include detailed calculations of the probability of detection and interception algorithms used in the model to calculate the time between detections and the time to intercept. This is one volume of a three volume set that describes PATROL. Volume II is a user's manual for the model. Volume III includes all of the programmer level documentation necessary to maintain the model.
REPORT NUMBER: CGR/DC-15/86-VOL-1; USCGD-05-87-V0L-1
ACCESSION NUMBER: ADA178168

Proceedings of the Ship Control Systems Symposium (7th) Held in Bath, **England on 24-27 September 1981**. Volume 1. Ministry of Defence, Bath (England): 27 September 1984. 115p. [See also Volume 2, **ADA211134**.]
ABSTRACT: Contents: Digital progress in the Royal Navy; US Navy control systems overview; Machinery control initiatives -- A Canadian perspective; Ship automation -- A Dutch view on practice and progress; Digital control and surveillance system for the M-Class frigate of the Royal Netherlands Navy; Propulsion control in the Swedish M80 Class Mine Countermeasures Ships; Practical experience in the application of microprocessors to machinery control and surveillance; Multivariable adaptive control of ships motions; A classical approach to a microprocessor based PID Autopilot design; Model tests and full-scale trials with a rudder-roll stabilisation system.
ACCESSION NUMBER: ADA211133
http://handle.dtic.mil/100.2/ADA211133

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 2. Study Review Summaries. Part I**. Final report. 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 485p.

ABSTRACT: Contents: Airborne ASW; Airborne AAW; Airborne attack; Environmental systems; Mining; Mine countermeasures; Ocean surveillance; Submarine ASW; Submarine attack; Surface ASW.

ACCESSION NUMBER: AD0912444

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 3. Study Review Summaries. Part II**. Newport Beach, CA: Ultrasystems Inc., 31 October 1972. 469p.

ABSTRACT: Contents: Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; Undersea surveillance; Amphibious assault; Reconnaissance/intelligence; Logistics; Special warfare; Airborne ASW and submarine ASW; airborne asw and surface asw; airborne asw and undersea surveillance; airborne aaw and airborne attack; airborne attack and surface aaw; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mining and mine countermeasures; mine countermeasures and navigation; Ocean surveillance and electronic warfare; Submarine asw and surface asw; submarine asw and surface asw; Submarine attack and surface asw; surface asw and surface attack; surface aaw and surface attack; Surface aaw and electronic warfare; logistics and ship support; Airborne AAW, surface aaw and electronic warfare; airborne attack, surface attack and amphibious assault; airborne attack, surface attack and special warfare; Submarine ASW, submarine attack and surface ASW; airborne asw, submarine asw, submarine attack and sea based strategic systems; submarine asw, submarine attack, surface asw and surface attack; and airborne asw, ocean surveillance, submarine asw, surface asw and undersea surveillance.

ACCESSION NUMBER: AD0912445

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 4. MOE Reviews**. Final report 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 226p.

ABSTRACT: Contents: Airborne ASW; airborne attack; Mining; Mine countermeasures; Ocean surveillance; submarine ASW; Surface ASW; Surface ASW; Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; undersea surveillance; Amphibious assault; Naval communications; Command and control; Reconnaissance/ intelligence; airborne ASW and surface ASW; airborne AAW and airborne attack; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mine countermeasures and amphibious assault; submarine ASW and command and control; submarine attack and surface ASW; submarine attack and surface attack; surface ASW and surface attack; surface AAW and surface attack; surface AAW and command and control; surface attack and amphibious assault; electronic warfare and naval communications; Logistics and ship support; airborne ASW, ocean surveillance and surface ASW; airborne ASW, submarine ASW and submarine attack; airborne AAW, airborne attack and surface AAW; mine countermeasures, command and control and navigation; airborne ASW, airborne AAW, surface ASW and surface AAW; airborne ASW, mining, submarine ASW, submarine attack, surface ASW, logistics and ship support; and airborne AAW, airborne attack, electronic warfare, naval communications, command and control, reconnaissance/ intelligence, logistics and special warfare.

ACCESSION NUMBER: AD0912446

Ray, Gregory P. **Bomb Strike Experiment for Mine Clearance Operations.** Monterey, CA: Naval Postgraduate School, 2006. 212p.

ABSTRACT: The Bomb Strike Experiment for Mine Countermeasure Operations, currently sponsored through the Office of Naval Research mine impact burial prediction project, is part of a multi-year, comprehensive effort aimed at enhancing the Navy's fleet naval mine clearance capability and success. The investigation discussed in this paper examines the experimental and theoretical characteristics of a rigid body falling through the air, water, and sediment column at high speed. Several experiments were conducted to launch bomb-like rigid bodies with the density ratio similar to operational munitions, namely the MK-84 general purpose bomb, into a hydrodynamic test tank. Careful observations of the bomb-like rigid body's position and orientation were collected and analyzed to produce a series of three-dimensional coordinate time-space data tables and plots. The resulting data set reveals a strong correlation between shape type and trajectory and dispersion patterns for rigid bodies moving through the water column at high velocity. This data will be used for numerical verification of the initial three- dimensional model (STRIKE35) aimed at predicting the overall trajectory, maneuvering, burial depth and orientation of a falling high-velocity rigid body in the air-water-sediment column. The long-term goal of this project is to improve warhead lethality for use in quick, precise and accurate strikes on known enemy naval minefields in the littoral combat environment.

ACCESSION NUMBER: ADA445556

http://handle.dtic.mil/100.2/ADA445556

http://edocs.nps.edu/npspubs/scholarly/theses/2006/Mar/06Mar_Ray.pdf

Reams, William H. **Combined Mine Safety Deployment and Activation System**. Washington, DC: Department of the Navy. Patent filed 21 May 1984, patented 9 Apr 1991. 7p.

ABSTRACT: A naval mine combined fail-safe deployment and activation system which, after the mine has been dropped from an aircraft, deploys a parachute to slow its descent and thereafter arms a target detection device when the mine has settled into the water to a predetermined depth for exploding the mine when a target is detected.

REPORT NUMBER: PATENT: 5,005,482

http://www.uspto.gov/patft/

Reese, Sudha, Gita Sukthankar, and Rahul Sukthankar. **An Efficient Recognition Technique for Mine-Like Objects Using Nearest-Neighbor Classification**. Proceedings of Undersea Technology Europe. 2003.

Abstract: *Broadband active sonars (15-150 kHz) capture morphological characteristics of underwater objects and are used by dolphins to recognize targets in cluttered environments, motivating their use in underwater mine countermeasure applications. However, the data from broadband sonars is very high-dimensional (typically 1400), requiring classification algorithms that can operate in these spaces with limited training data. Standard statistical approaches such as probability density estimation are often ill-suited to this task. This paper presents a new algorithm for mine-like object recognition that has shown promising results during in-water tests. The technique employs a nearest-neighbor classifier in conjunction with a non-metric similarity function and synthetic augmentation of the training data. Experimental results are presented comparing this method to a standard algorithm (LDA/PCA) and indicating that the nearest-eighbor approach addresses some deficiencies in existing techniques for the mine-like object recognition problem*.

http://www.cs.cmu.edu/~rahuls/pub/udteuro2003-reese.pdf

Reilly, Kevin D. **Experimental Evaluation of a Low Cost Acoustic Communication System for AUVs**. Monterey, CA: Naval Postgraduate School, June 1996. 100p.

ABSTRACT: As the Navy has refocused its goals towards littoral warfare, mine countermeasures have become an area of special interest. The Naval Postgraduate School is developing an autonomous underwater vehicle to map shallow water minefields--a vital role in the Navy's overall plan for mine countermeasures. A key feature of the vehicle is its low cost, and to this end it uses a commercially available system called 'DiveTracker' for precise acoustic navigation and communication. This research experimentally evaluated the reliability of the DiveTracker communication system in conditions approximating those for which the vehicle is designed. It was concluded that highly reliable communication of short commands will be restricted to relatively short separation distances between nodes. The very shallow water acoustic channel is highly variant in both signal attenuation and background noise levels. The maximum range is limited by the background noise while the probability of correct message reception depends on the received signal to noise ratio. Initial data indicates that the low cost unit under development cannot communicate beyond 500 meters with a probability of a single roundtrip success greater than 34 percent. Several options are available for its improvement.

ACCESSION NUMBER: ADA313850

http://handle.dtic.mil/100.2/ADA313850

http://edocs.nps.edu/npspubs/scholarly/theses/1996/Jun/96Jun_Reilly.pdf

Report of the Mine Warfare Study Group. Volume 8. The SWATH as an MCM (Mine Countermeasures) Platform. Washington, DC: National Academy of Sciences, National Research Council, September 1982. 80p.

ABSTRACT: The following are among the Task Groups findings: (1) A SWATH hull form displacing 33 to 54 t appears to have excellent seaworthiness characteristics for the inshore MCM mission while housing ample payload for minehunting with limited neutralization. (2) The seakeeping characteristics predicted for the SWATH hull form will permit a hull mounted sidelooking sonar option with minimum yaw compensation and no roll and pitch compensation. (3) The results of computer predictions of the motions of the two proposed SWATH designs show that, when suitably averaged for all headings, and when operating at 6 kt in a state 3 sea the roll angle amplitude for all designs will be less than 2 deg; the heave amplitude at the LCG will be approximately 2 ft; and the LCG accelerations approximately 0.04 g. These small motions and accelerations provide a comfortable working environment for crew and instrumentation. and (4) The comparative seaworthiness of a monohull, ASR Catamaran form, and MCM SWATH in the same environment are presented. The motions and accelerations of the SWATH hulls were substantially less than those for monohull and catamaran.

ACCESSION NUMBER: ADA133442

http://handle.dtic.mil/100.2/ADA133442

Ricci, Jospeh J. **Preliminary Risk Assessment of the Remote Minehunting System (RMS).** Washington, DC: Naval Sea Systems Command, 23 October 1991. 32p.

ABSTRACT: This Risk Assessments of the RMS rates the risks associated with developing the sub-systems and components of the RMS. The risks are identified as low, medium, and high level so that high risk may be provided the highest resource priority.

ACCESSION NUMBER: ADA255805

http://handle.dtic.mil/100.2/ADA255805

Richardson, Michael D. **Coastal Benthic Boundary Layer Special Research Program.** Program Direction and Workshop Recommendations. Final report. Stennis Space Center, MS: Naval Oceanographic and Atmospheric Research Laboratory, August 1992. 164p.

ABSTRACT: A 5-year Special Research Program (SRP) has been established at the Naval Research Laboratory that addresses the physical characterization and modeling of benthic boundary layer processes and the subsequent impact of these processes on the seafloor properties that affect mine countermeasure operations. This special project outlines the SRP scientific program and reviews the results of the four workshops convened to establish scientific priorities. Workshop participants agreed that sediment structure provides the common perspective: to quantitatively model relationships among sediment physical properties; to quantify the effects of environmental processes on sediment properties; and to model sediment behavior (acoustic, electrical, and mechanical). Hypotheses based on quantitative physical models that incorporate three-dimensional sediment structure will be tested by a series of field experiments at coastal locations where differing environmental processes dominate sediment structure. These experiments stress the role of sediment structure in determining high-frequency acoustic phenomena such as scattering, penetration, and propagation, as well as the physical relationships between remotely sensed acoustic properties and mechanical strength parameters.

ACCESSION NUMBER: ADA256608

http://handle.dtic.mil/100.2/ADA256608

Richardson, Michael D. **Investigating the Coastal Benthic Boundary Layer**. Stennis Space Center, MS: Naval Research Laboratory Detachment, 26 April 1994. 4p.

ABSTRACT: Recent geopolitical changes have shifted the emphasis of U.S. naval operations from deep ocean to nearshore coastal regions. In response to this shift, the Office of Naval Research (ONR) established the Coastal Benthic Boundary Layer Special Research Program (CBBLSRP) at the Naval Research Laboratory to study the impact of the environment on mine countermeasure systems. CBBLSRP studies physical characterization and modeling of benthic boundary layer processes and the impact these processes have on seafloor properties that affect shallow-water naval operations. Special emphasis will be placed on measuring and modeling sediment three-dimensional structure. Studying sediment physical structure allows us to model relationships among sediment physical, acoustic, -electrical, and rheological properties; quantify the effects of environmental processes on the spatial and temporal distribution of sediment properties; and model sediment behavior under direct and remote stress. Predictive models developed through this program should enhance MCM technological capabilities in several important areas, including acoustic/magnetic detection, classification, and neutralization of proud and buried mines; prediction of mine burial; and sediment classification.

REPORT NUMBER: NRL/JA/7431-93-0014

ACCESSION NUMBER: ADA299087

http://handle.dtic.mil/100.2/ADA299087

Riedel, Jeffrey S. **Seaway Learning and Motion Compensation in Shallow Waters for Small AUVS**. Monterey, CA: Naval Postgraduate School, June 1999. 264p.

ABSTRACT: The continual development of computer technology has enabled the expansion of intelligent control into the field of underwater robots, where potential uses include oceanographic research, environmental monitoring and military mine countermeasures. With the naval focus shifting to operations in the littorals, and the need to lower cost of operations, tetherless autonomous vehicles are now being proposed for use in very shallow water minefield reconnaissance. These areas are dominated by a highly energetic environment arising from waves and currents. Motion control in such an environment becomes a difficult task and is the *subject of this work. The main objective of this dissertation, is to show through modeling and simulation, and in-ocean experimental validation, that intervention tasks performed by intelligent underwater robots are improved by their ability to gather, learn and use information about their working environment. Using a new generalized approach to the modeling of underwater vehicles, which directly includes disturbance effects, a new Disturbance Compensation Controller (DCC) is proposed. The DCC, employing onboard vehicle sensors, allows the robot to learn and estimate the seaway dynamics. This self-derived knowledge is embedded in a non-linear sliding mode control law which allows significantly improved motion stabilization. The performance of the DCC has been verified in Monterey Harbor using the NPS phoenix AUV.*

ACCESSION NUMBER: ADA367306

http://handle.dtic.mil/100.2/ADA367306

http://edocs.nps.edu/npspubs/scholarly/theses/99Jun_Riedel.pdf

Robbins, A. B. **Study of the Use of Nets in Mine Detection**. New Haven, CT: Yale University, Laboratory of Marine Physics, October 1954.

ABSTRACT: None Available.

ACCESSION NUMBER: AD063370

Rodgers, Anthony C. **ML-Recon Simulation Model: A Monte Carlo Planning Aid for Magic Lantern**. Monterey, CA: Naval Postgraduate School, September 1995. 51p.

ABSTRACT: The U.S. Navy currently has no means to conduct sea mine reconnaissance with assets that are organic to Aircraft Carrier Battle Groups or Amphibious Ready Groups. Magic Lanten is an Airborne Laser Mine Detection System (ALMDS) under development, that is designed to search for floating and shallow moored mines using a helicopter- mounted laser-optic sensor. It is the only ALMDS operationally tested by the Navy to date. This thesis develops a Monte Carlo simulation model called ML-Recon, which is intended for use as a tool to plan mine reconnaissance searches using the Magic Lantern system. By entering fundamental initial planning information, the user can determine the number of uniformly-spaced tracks to fly with a Magic Lantern-equipped helicopter to achieve a certain level of assurance that the area contains no floating or shallow moored mines. By employing Monte Carlo methods, ML-Recon models the three primary stochastic processes that take place during a typical search: the location of the mines, the cross-track error of the helicopter, and the detection/non-detection process of the sensor. By running ML-Recon, the user is given performance statistics for many replications of the search plan that he chooses. This approach is unique in that it provides the user with information indicating how much worse than the mean performance his plan may perform. ML-Recon also gives the user an Opportunity to view an animation of his lan, which he can use to look for tendencies in the lan to contain holes, or holidays.

ACCESSION NUMBER: ADA304223

http://handle.dtic.mil/100.2/ADA304223

http://edocs.nps.edu/npspubs/scholarly/theses/95Sep_Rodgers.pdf

Rossi, Gary. L. **Explosive Ordnance Disposal (EOD) Mine Countermeasure (MCM) Tactics Development Plan**. Master's thesis. Redlands, CA: University of Redlands, 1994.

ABSTRACT: Presently, Explosive Ordnance Disposal (EOD) Mine Countermeasures (MCM) detachments are only proficient in two types of diving area searches. During Desert Shield and Desert Storm, EOD MCM detachments were tasked to conduct larger area searches, requiring the expertise in a variety of clearance diving techniques. After Desert Storm, EOD MCM detachments started training in the various clearance diving techniques depicted in the Allied Tactical Publications (ATPs). However, the search rates and probabilities of detection of the clearance diving techniques were and still not supported by data. Therefore, our current EOD

MCM Detachment officers-in-charge and senior enlisted EOD technicians are not provided with data based information which is necessary in providing valid recommendations to the Commander, Carrier Battle Group or Commander, Amphibious Ready Group in a situation such as Desert Shield or Desert Storm.

Russell, Bruce F. **Operational Theater Mine Countermeasures Plan: More Than a Navy Problem**. Monograph. Fort Leavenworth, KS: Army Command and General Staff College, 14 May 1995. 54p.

ABSTRACT: This monograph finds that theater commanders, with vital maritime choke points/canals in their theater, should have their J-5 planners develop and integrate a comprehensive counter mine plan into the theater's campaign plans. In the past, regional mine countermeasure's plans have been viewed as a Navy responsibility. However, today's theater commander may face short regional conflict warning times which require the conduct of mine countermeasures (MCM) operations before Naval MCM planners and their forces (ships and aircraft) can arrive in theater. Using joint theater forces (Army, Air Force, Special Operations Forces, Navy, and Space assets), the theater commander can conduct MCM operations to prevent mines from going in the water or to detect and record locations of enemy mine laying operations, reducing greatly the time required for counter mine operations by Naval MCM ships and aircraft upon their in-theater arrival. The coordination and allocation of Joint theater forces to conduct MCM operations requires a theater commander to plan and prepare for mining threats long before the first enemy sea mine enters the water. This monograph uses the Secretary of Defense's October 1993 Report on the Bottom-Up Review as a reference, to identify real world MCM missions from a scenario that involves two nearly simultaneous conflicts in the Korean and Persian Gulf regions. To execute counter mine missions in these theaters, the J-5 planning staffs must develop MCM plans for the theater commander. This monograph takes the J-3 planner through the required building blocks to develop an effective theater MCM plan. The monograph describes the North Korean and Iraqi mining threats, past and present, to include mine types, mine delivery platforms, and possible battlespace areas that could be effectively mined. The strengths and weaknesses of U.S. MCM forces, ships and aircraft.

ACCESSION NUMBER: ADA301152

http://handle.dtic.mil/100.2/ADA301152

Savage, Kristen D. and Roger W. Meredith. **Modeled High-Frequency Acoustic Backscattered Levels from Range-Independent and Simplistic Range-Dependent Sand Bottoms**. Final report. Stennis Space Center, MS: Naval Research Laboratory Detachment, 21 February 1996. 17p.

ABSTRACT: Results investigating the effects of variable bottom composition on modeled high-frequency backscattered levels are presented for a typical shallow-water, variable bottom (range-dependent) environment. The modeled environment consisted of a single sound speed profile, a flat sea bottom with range-dependent bottom composition, and a smooth, flat sea surface. Coarse-and fine-grained sandy areas were partitioned in range to create range dependence. Bottom backscattering and reflection loss for each partition were obtained from a recent University of Texas high-frequency ocean bottom backscatter model. Maximum differences of S dB were discernible between the fine- coarse-fine sand bottom and a range-independent fine-sand bottom for ranges <500 m. The trend and structure of the backscattered levels were nearly identical for both bottom types. In all cases, surface reverberation had a strong impact on the backscattered levels, trends, and structures.

ACCESSION NUMBER: ADA305987

http://handle.dtic.mil/100.2/ADA305987

Scarzello, John F., Peter B. Keller, and Richard W. Harrison. **Mine Sweeping System for Magnetic and Non-Magnetic Mines**. Washington, DC: Department of the Navy. Patent filed 29 December 1994, patented 28 January 1997. 15p.
ABSTRACT: A mine sweeping system including deployable horizontal antennas to establish a detection and navigation grid extending underwater from a beach to a distance offshore. A computer-controlled transmitter unit having a waveform generator and amplifier, transmits signals to each antenna, at unique frequencies and phases for different spatial locations within the grid. An autonomous underwater vehicle having multi-integrated sensors detects anomalies in the electromagnetic field caused by both magnetic and non-magnetic objects therein during underwater travel utilizing the electromagnetic field as a navigational grid. The autonomous underwater vehicle also deposits mine clearing explosives at each magnetic anomaly for detonation under command signal using the horizontal antennas which provide a means for establishing a navigation grid to permit landing craft and other vessels to navigate in the region cleared of mines.
REPORT NUMBER: PATENT: 5,598,152
http://www.uspto.gov/patft/

Seguin, John M. **Simulating Candidate Missions for a Novel Glider Unmanned Underwater Vehicle.** Monterey, CA: Naval Postgraduate School, March 2007. 120p.
*ABSTRACT: Unmanned Underwater Vehicles (UUVs) are becoming ubiquitous in the framework of U.S. Navy operations. According to the U.S. Navy*s UUV Master Plan (2004), research and development will expand UUV capabilities that enable diverse roles from Intelligence, Surveillance, and Reconnaissance (ISR) and Mine Countermeasures to Anti-Submarine Warfare (ASW) and Information Operations (IO). However, typical UUVs are severely limited in operational characteristics such as endurance and range which prevents their use conducting certain missions. A novel UUV is currently being designed that is projected to support significantly greater endurance and range characteristics. This UUV is called Seadiver and is being designed by Institute of Engineering Science of Toulon, France with support from Naval Postgraduate School. It is a low-cost glider UUV which generates propulsion not with propellers or jet pumps, but rather by controlling its buoyancy. This method of propulsion is quite efficient and maybe capable of autonomous operation up to 30 days with a range of around 700 nautical miles. A UUV with such endurance and range exposes military missions previously impractical for UUVs especially when used in concert as an array of many UUVs. This thesis creates a simulation using NPS-produced software simulation tools Simkit, Viskit and AUV Workbench that analyzes the capabilities and effectiveness of Seadiver UUVs conducting missions of tactical interest.*
ACCESSION NUMBER: ADA467375
http://handle.dtic.mil/100.2/ADA467375
http://edocs.nps.edu/npspubs/scholarly/theses/2007/Mar/07Mar_Seguin.pdf

Sheetz, Kraig E. **Advancements in Buried Mine Detection Using Seismic Sonar**. Monterey, CA: Naval Postgraduate School, December 2000. 95p.
ABSTRACT: Buried mines continue to disrupt the U.S. ability to project naval power ashore, conduct amphibious assaults, and wage land campaigns. Ibis thesis describes advances in the development of a seismic sonar research tool that resulted in the successful detection of a Mk-63, 1000 Ib, mine shape and a M-19, 20 lb, anti-tank mine. This seismic sonar research investigates the concept of using echo returns of a particular seismic interface wave, known as a Rayleigh wave, to detect buried mines. Rayleigh waves are unique in that they have elliptical particle motion that allows one to use vector polarization filtering to separate Rayleigh wave target reflections from other body waves with linear particle motion. A new source design employed in an array of seven elements has been shown to form a narrow beam of Rayleigh wave energy in a

sand medium at the navy beach test site. This source beam, coupled with the receiver beam formed by an array of five three-component seismometers has provided a successful bi- static seismic sonar configuration. Signal to noise ratios of 21 dB for the Mk- 63 mine shape, and 9 dB for the M-19 anti-tank mine were observed in the target echoes. These experimental results suggest that the seismic sonar is a very promising concept for buried mine detection.

ACCESSION NUMBER: ADA386340

http://handle.dtic.mil/100.2/ADA386340

http://edocs.nps.edu/npspubs/scholarly/theses/00Dec_Sheetz.pdf

Shen, Jonah W. **Finite Difference Methods Applied to Biot Theory in Porous Medium**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1995. 55p.

ABSTRACT: Finite difference methods are used to solve the Biot equations for wave propagation in a porous medium. The computational domain is a two dimensional grid of uniform spacing where truncation of the grid on all sides is accomplished by applying homogeneous Dirichlet boundary conditions. The difference method is second order in space and time, and is seen to accurately predict phase speeds of the primary compressional and shear waves.

ACCESSION NUMBER: ADA306214

http://handle.dtic.mil/100.2/ADA306214

Shinego, Michael, et al**. Underwater Acoustic Data Communications for Autonomous Platform Command**, **Control and Communications**. Nashua, NH: BAE Systems and Technology, 12 February 2001. 140p.

ABSTRACT: The purpose of this study is to provide an analysis and assessment of the state-of-the-art of underwater acoustic (UWA) data communications technology with application to multiple vehicle operation in support of shallow-water mine countermeasures (MCM) operations. This study is intended to provide system architects with a reference to what the current state of acoustic communications technology can provide and to support the execution of system architecture trades. Included are discussions and analyses that may be used to predict the performance, strengths, and limitations of different approaches to acoustic communications in facilitating the overall MCM system approach. Not only does the underwater environment constrain the data rates achievable but it also limits the maximum ranges achievable. Acoustic attenuation in the ocean is frequency-dependent with higher frequencies propagating shorter distances. The requirement to provide connectivity to submerged Naval assets over very long ranges is unlikely to be met directly with a single acoustic link due to the complex effects of acoustic propagation and limited propagation ranges. One solution is to create an UWA network of communications nodes. Another solution to this requirement is to use a buoy to convert acoustic signals to and from radio frequency (RF) signals. This solution provides real-time two-way communications to distant surface ships, aircraft and/or satellites that can act as relays to integrate undersea communications into the RF-based communications network.

ACCESSION NUMBER: ADA386718

http://handle.dtic.mil/100.2/ADA386718

Steel, Nelson, Michael Philips and Georgianna Meagher. **Interactive Neural Network System for Acoustic Signal Classification**. Final report. 1 September 1989-28 February 1990. Columbia, MD: Advanced Resource Development Corporation, 28 February 1990. 123p.

ABSTRACT: The objectives of this project was to develop an understanding of the effect of neural networks, implemented in interactive systems, on sonar operators and other naval personnel. Specifically, the project called for the development of a prototype system, employing neural networks to test the effect of interactive (man-in-the-loop) operations. ARD developed

such a system which is used to classify time domain signals generated from the insonification of an underwater mine-like target. The system converts the time domain signals to frequency domain and frequency over time (spectrograms) and displays the signals at the users' request in all three formats. A time windowing function is also provided to allow the user to closely inspect specific portions of the time domain signal. In addition, a neural network system classifies the signal according to three parameters: shell thickness, interior content and angle of insonification. Results have shown that most users exhibit a large bias towards the use of the neural network analysis because of their highly accurate classification. Future work will concentrate on the integration of neural network tools into existing systems in real-world situations. A better understanding of the human-network interactions will be gained when the ability of the networks to classify real world signals is decreased due to the complex geometries of actual mines and environmental effects on the sonar returns (thermoclines, shallow water, surface returns).
ACCESSION NUMBER: ADA219278
http://handle.dtic.mil/100.2/ADA219278

Stuart, G.C. **Infrared Reflectance Measurements of Replica Mines and Reference Targets**. Memorandum report. Ralston (Alberta): Defence Research Establishment Suffield, February 1989. 49p.
ABSTRACT: Remote minefield detection (RMD) can be performed by mounting downward-looking sensors on airborne platforms such as remotely-piloted vehicles (RPVs). Scatterable mines lying on the surface of the ground may be detected using a carbon-dioxide laser mounted on the RPV as a source of thermal infrared radiation and by measuring the reflected signals to create an image of the terrain below. Such an active infrared system is capable of operating covertly at all times of the day or night and makes use of much of the technology found in current passive infrared sensors (i.e. forward-looking infrared imagers, FLIRs, on military aircraft, ground vehicles, and ships). This report presents reflectance data on a number of replica mines which have been found to be specular (mirror-like) at thermal IR wavelengths. The measurements of the replica mines and a number of reference materials were made in a laser laboratory, and retro-reflectivity data for each target are presented graphically as a function of the angle at which the IR laser beam hit the target surface. The fact that the replica mines are specular means that the RMD sensor must be downward-looking and only those mines within a fairly small angular field-of-view will give significantly large reflected signals.
ACCESSION NUMBER: ADA209084
http://handle.dtic.mil/100.2/ADA209084

Stuart, G. C. **Remote Minefield Detection Using Infrared Laser Radar.** Memorandum report. Ralston (Alberta): Defence Research Establishment Suffield, November 1988. 131p.
ABSTRACT: High-resolution infrared laser radars are shown to be effective sensors for use in remote minefield detection (RMD). The theoretical aspects and practical limitations of imaging laser radars are discussed and the conceptual designs of two airborne carbon-dioxide laser radars are presented. A design which uses direct detection and a linear-array detector is shown to be superior to one using heterodyne detection and a single-element detector. Countermeasures to active infrared RMD systems are discussed and suggestions made for further study.
ACCESSION NUMBER: ADA202206

Sulzberger, G., et al. **Hunting Sea Mines with UUV-Based Magnetic and Electro-Optic Sensors**. Panama City, FL: Naval Surface Warfare Center, 2010. 5p. [conference paper]
ABSTRACT: The US Navy (USN) has recognized the need for effective buried-mine hunting as one of its Organic Mine Countermeasures (MCM) Future Naval Capabilities. Current thinking

envisions a two-step process for identifying buried mines. First, an initial survey, or Search-Classify-Map (SCM) mission, will be performed using low-frequency synthetic aperture sonar (SAS). Second, a Reacquire-and-Identify (RI) mission will provide confirmatory final classification by reacquiring the target, at close range, with magnetic, acoustic, and electro-optic sensors, and evaluating properties such as geometric details and magnetic moment that can be fused to identify or definitively classify the object. The goal is to demonstrate a robust capability to identify buried sea mines through sensor fusion. Specifically, the classification results of a passive magnetic sensor and an electrooptic sensor will be generated for fusion with the results from a short-range bottom-looking sonar, with all three sensors coresiding and operating simultaneously on an Unmanned Underwater Vehicle (UUV). The Bluefin12 Buried Mine Identification (BMI) System will be used as the platform to develop a capability for the identification of buried mines. This system houses the bottom looking sonar, the Real-time Tracking Gradiometer (RTG), and an Electro-Optic Imager (EOI). This paper will address the applications of the RTG, EOI, and data fusion results with bottom looking sonar. The objective for the RTG is the enhancement of the processing that extracts target locations and magnetic moments from the raw RTG data. In particular, we are adding a capability to conduct real-time processing capability to provide autonomous target classification and localization results soon after the UUV passes the target, while the system is still performing the mission.

ACCESSION NUMBER: ADA527389
http://handle.dtic.mil/100.2/ADA527389

Surface Impact Detection and Scoring. White Sands Missile Range, NM: Range Commanders Council, Underwater Systems Group, October 1996. 29p.
ABSTRACT: At present, naval underwater ranges require or desire a capability for surface impact detection and scoring involving mine exercise sonobuoy drops, air launched torpedoes, naval gunfire, and missile firings. The objective of this task is to establish a common approach for surface impact detection and scoring based on member and associate member inputs. Technical requirements such as types of impacts, accuracy and coverage area will be determined. Operational requirements such as level of automation and impact classification will be defined. The ultimate goal is to develop a single system design that will meet all of the requirements at the various ranges. With a surface impact detection and scoring system standardized and the associated software baselined, overall life cycle cost to individual ranges can be substantially reduced. In addition, new developments and system enhancements can be shared between ranges, reducing the per range cost of each improvement.

ACCESSION NUMBER: ADA317897
http://handle.dtic.mil/100.2/ADA317897

Taber, Victoria L. **Environmental Sensitivity Study on Mine Impact Burial Prediction Model**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1999. 50p.
ABSTRACT: The Navy's Impact Burial Prediction Model creates a two dimensional time history of a bottom mine as it falls through air, water, and sediment. The output of the model is the predicted burial depth of the mine in the sediment in meters, as well as height, area and volume protruding. Model input consists of environmental parameters and mine characteristics, as well as parameters describing the mine's release. The model user seldom knows many of these parameters, and those that are known may be of questionable precision. In order to determine which parameters had the greatest effect on the model and which could be simplified or eliminated, a series of sensitivity tests were performed. It was found that the model data ingest could be greatly simplified without sacrificing accuracy too much. However, several parameters including sediment shear strength were found to have a large effect on the model and were investigated flirter.

ACCESSION NUMBER: ADA361822
http://handle.dtic.mil/100.2/ADA361822

http://edocs.nps.edu/npspubs/scholarly/theses/99Mar_Taber.pdf

Tan, Yong Chye. **Synthesis of a Controller for Swarming Robots Performing Underwater Mine Countermeasures.** Annapolis, MD: Naval Academy, 2004. 111p.
ABSTRACT: This Trident Scholar project involved the synthesis of a swarm controller that is suitable for controlling movements of a group of autonomous robots performing underwater mine countermeasures (UMCM). The main objective of this research project was to combine behavior-based robot control methods with systems-theoretic swarm control techniques to achieve a hybrid that has the best characteristics of both. The sub-goals were: a) To simulate and study a simplified version of the UMCM problem, in 2D with basic robot dynamics and behaviors. b) To investigate the performance of both behavior-based and systems-theoretic controllers for UMCM, and to determine their advantages and disadvantages. Careful development of behavior-based methods using a non-traditional differential equations approach facilitated the hybridization of the two controllers under study, giving rise to a more functional controller capable of controlling swarm level functions while executing the appropriate behaviors at the same time.
ACCESSION NUMBER: ADA24661
http://handle.dtic.mil/100.2/ADA424661

Tarr, Paulo Bertell. **Mine Littoral Threat Zone Visualization Program**. Patent. Washington, DC: Department of the Navy, February 2004. 4p.
ABSTRACT: Computer-implemented methodology for being visually informative as to risks associated with sea mines which may be present in geographical regions of interest. A region is selected, topographical data pertaining to such region is acquired, a "safe-depth" (water depth demarcation between significant risk thereabove and insignificant risk therebelow) is designated, and a map of such region is displayed. In a visibly differentiable manner, the map depicts existing water areas in which sea mine risk is significant, existing water areas in which sea mine risk is insignificant, and existing land areas. In relation to a particular region, the nature and bounds of sea mine risk and/or lack thereof can be readily, completely and detailedly ascertained by viewing a computer display and effectuating appropriate computer operations. On individual ships, alarms can be installed which suitably actuate responsively to sea mine risks.
REPORT NUMBER: PATENT: 6,686,917
http://www.uspto.gov/patft/

Tarr, Paulo Bertell. **Shipboard System for Furnishing Information on Mine Threat Vulnerability**. Patent. Washington, DC: Department of the Navy, May 2002. 33p.
ABSTRACT: Data on influencing signatures of world-wide sea mine models is collected on board a host sea vessel and undergoes periodic updating to maintain accuracy of the display on vessel vulnerability to such sea mines, obtained on-board from such collected data, measurements of current status conditions of the host vessel and calculation therefrom of surface actuation onsets with respect to each of the sea mine models.
REPORT NUMBER: PATENT: 6,385,514
http://www.uspto.gov/patft/

Thompson, J.L and M.J. Bell. **Evaluation of the Performance of a Minehunting Sonar.** Melbourne, Victoria, Australia: Department of Defence, Defence Science and Technology Organization, 1997. 27p.
ABSTRACT: *A methodology to measure the detection and classification performance of a minehunting sonar is outlined. A technique for specifying the detection and classification performance in a contract and then relating that to the performance*

measured in sea trials is described. The report also shows how a model can be used to adjust the required performance to allow for the effects of the environment.

REPORT NUMBER: DSTO-TN-0123

http://www.dsto.defence.gov.au/publications/2105/DSTO-TN-0123.pdf

Tooma, Samuel, et al. **Collaborative Efforts Within the Key West Campaign Sea Test February 1995**. Stennis Space Center, MS: Naval Research Laboratory Detachment, 8 August 1995. 18p.

ABSTRACT: During February 1995, four research vessels (WFS PLANET, RN SEAWARD JOHNSON, RN PELICAN, and RN SEAWARD EXPLORER) and 115 scientists and technicians from five nations mounted a major scientific campaign in waters of the western Florida Keys. Scientific experiments during this Key West Campaign focused on the shallow-water carbonate sedimentary environments in the vicinity of the Marquesas Keys and the Dry Tortugas. The Florida Keys provide the only environment in continental US waters which is analogous to the shallow-water tropical carbonate settings that are becoming increasingly important to naval operations (e.g., Persian Gulf) and where the biogeochemical processes that are typical of those carbonate environments can be studied. In this report, objectives of participating programs, preliminary data from selected scientific instrumentation, and benefits to MCM operations are highlighted. (MM).

REPORT NUMBER: NRL/MR/7430--95-7694

ACCESSION NUMBER: ADA299597

http://handle.dtic.mil/100.2/ADA299597

Trenchard, Michael E., et al. **Two-Part Study on the Use of Bathymetric and Nautical Mapping Information in a Moving Map Display to Support Mine Counter Measures Operations**. Stennis Space Center, MS: Naval Research Laboratory Detachment, 21 August 2000. 9p.

ABSTRACT: Cockpit moving map displays have been employed in the tactical air community for several years to support air-to-air and air-to-ground missions and have been shown to be excellent situational awareness (SA) tools. This study examines the potential of using the next-generation cockpit moving map display to support the difficult Mine Counter Measures (MCM) and Mine Sweeping Operations. Specifically, the Naval Research Laboratory - Stennis Space Center (NRLSSC) will leverage the Naval Air Systems Command's Tactical Aircraft Moving Map Capability (TAMMAC) digital moving map system as a demonstration platform to incorporate bathymetric and nautical map data designed to support in-flight MCM operations. Of critical importance to this project is a two-part human factors study to: (1) determine MCM helicopter aircrew preferences from the various types of map data under consideration, and (2) measure and evaluate aircrew performance both with and without the moving map capability. This study is being conducted as part of NRLSSC's Generation and Exploitation of Common Environment (GECE) project that will Support MCM and amphibious operations in Fleet Battle Experiment - India (FBE-I) or Kernal Blitz 2001 (KB 01).

REPORT NUMBER: NRL/PP/7440--00-0013

ACCESSION NUMBER: ADA385583

http://handle.dtic.mil/100.2/ADA385583

Tsaprazis, Konstantinos. **Design and Analysis of Side-Looking Sonar Experiments.** Monterey, CA: Naval Postgraduate School, 2006. 113p.

ABSTRACT: This research concerns the design and analysis of different Side-Looking Sonar experiments in order to satisfy different operational requirements. The different designs and analysis have been done via computer simulation. Side-Looking Sonar (also known as side-scan sonar) is known for very high quality, high resolution, ocean bottom imaging. Hence, it is used for *bathymetric surveys, commonly called seafloor mapping. It is able to rapidly survey large ocean areas for bottom and suspended sea-mines or other kinds of threats. Another operational aspect of these systems is that they allow autonomous underwater vehicles (AUVs) to conduct operations, mostly in shallow water and near land. Thus Side-Looking Sonar can be a very useful device in littoral warfare operations. This research has defined the basic parameters that rule the operation of a Side-Looking Sonar and, furthermore, analyzed various aspects that affect the performance of these parameters. Special focus was given to the various operational requirements and conditions that a designer or a user may encounter in realistic situations. Toward that end, many numerical examples are presented. Moreover, the research has tried to indicate the various problems that may arise when a Side-Looking Sonar operates in its near-field region and suggests certain solutions. The active sonar equation and its factors were explained and were evaluated for a realistic example of mine detection as well.*

ACCESSION NUMBER: ADA462697

http://handle.dtic.mil/100.2/ADA462697

http://edocs.nps.edu/npspubs/scholarly/theses/2006/Dec/06Dec_Tsaprazis.pdf

van der Weiden, A. M. **RTPI Prototype.** Final report. The Hague, (Netherlands): Physics Laboratory, RVO-TNO, September 1997, 28p.

ABSTRACT: The Real Time Performance Indicator (RTPI) prototype system assesses the quality of mine detection using a sonar. The system is designed for the Alkmaar class mine hunters equipped with dedicated instrumentation for measurement of the sound velocity profile, the absorption and reverberation in the vicinity of the hunter at the time of the operation (hence real time). The quality of mine detection is expressed as a detection probability curve which indicated the detection probability as a function of the athwart distance and as A and B values which indicate the characteristic detection width and the characteristic detection probability. The system is enclosed in the OPPAS rack and uses many of the OPPAS system interfaces. RTPI incorporates the HUNTOP simulator which simulates a mine hunting operation (detection phase) using real world environment data and computes the desired probabilities.

REPORT NUMBER: FEL-97-A219

ACCESSION NUMBER: ADA332165

http://handle.dtic.mil/100.2/ADA332165

Walker, Charles L., et al. **Investigation of Potential Mapping Products Based on Acoustic Imagery from AN/SQS-53B ASW Sonar**. Stennis Space Center, MS: Naval Research Laboratory, Marine Geosciences Division, 24 June 1997. 37p.

ABSTRACT: Naval Research Laboratory (NRL) personnel collected acoustic backscatter data using the AN/SQS-53B ASW sonar on board the USS Monterey (CG-61) during transits of the Red Sea in November and December 1995. This report presents preliminary results on the potential of this type of data as a source of acoustic imagery for seafloor mapping. The AN/SQS-53B sonar operates at a frequency of 3.5 kHz giving it the ability to operate at long ranges. Its 12 geo-stabilized beams facilitate collects of multiple aspect angle coverages of the same area of the seafloor that the ship transits. The NRL data acquisition system works in conjunction with the sonar operation without interference. A preliminary comparison of the AN/SQS-53B sonar data with multibeam bathymetry, taken simultaneously by the Naval Oceanographic Office, shows that acoustic backscatter generally correlates with seafloor relief in both deep and shallow water. This observation leads to the main conclusion that an acoustic backscatter mapping product based on data collected during routine operations could enhance the utilization of the sonar in its primary mission of ASW, i.e., determination of optimum look-direction for ASW sonars and detection targets in high bottom-reverberation areas. A further implication of these results is that U.S. combatants operating in unfamiliar or poorly charted areas will have an on board capability to detect shoals or other navigational hazards well in front of the ship's movement.

REPORT NUMBER: NRL/MR/7441--97-8037
ACCESSION NUMBER: ADA328242
http://handle.dtic.mil/100.2/ADA328242

Watson, R. B., et al. **User Guide and Specification for Discrete-Event Minehunting Simulation Model MHUNT.** Canberra (Australia): Defence Science and Technology Organisation, March 1993. 75p.
ABSTRACT: *Minehunting is a complex process involving detection and classification of contacts using sonar and the subsequent identification and disposal of mines generally using a remotely operated underwater vehicle (ROV). However, making suitable assumptions, minehunting can be approximated by a series of connected events and thus made amenable to modelling using the technique of discrete-event simulation. In this report, a discrete-event minehunting simulation model is described together with instructions for its operation. The model can be applied to evaluate the effectiveness of minehunting systems for a given operational scenario and also to investigate new concepts.*
ACCESSION NUMBER: ADA304116
http://handle.dtic.mil/100.2/ADA304116

Wave Walker. Phase I. Final report. Pittsburgh, PA: Redzone Robotics, Inc., 30 November 1994. 34p.
ABSTRACT: Improved near shore mine detection and neutralization capability is needed by the U.S. Navy. Analysis of the littoral warfare mission and the Persian Gulf experience identified this need. The littoral warfare mission increases emphasis on near shore and amphibious operations. Mine detection and neutralization involves a number of tasks and many efforts are underway to improve existing capabilities. The Office of Naval Research is using the SBIR program as part of these capability improvement activities. Red Zone Robotics received a Phase 1 SBIR contract to develop a concept for a walking robot that can operate in near shore environments. This robot would be used to clear near shore areas of mines before an assault. In operation, many robots would be released near the mine field with a general heading for the area to be cleared. The robots would proceed to spread out and canvas the area for mines. When a robot encountered a mine, it would stop and enter a wait mode. If other robots discovered the same mine, they would sense that a robot was already there in wait mode. When the area had been adequately covered, explosive charges in the robots would be detonated to destroy the mines and the robots.
ACCESSION NUMBER: ADA288332
http://handle.dtic.mil/100.2/ADA288332

Weber, Timothy R. **An Analysis of Lemmings: A Swarming Approach to Mine Countermeasures in the VSW/SZ/BZ**. Monterey, CA: Naval Postgraduate School, December 1995. 103p.
ABSTRACT: Lemmings are autonomous tracked underwater vehicles which utilize a swarming approach to mine detection and neutralization in the very shallow water, surf and beach zones (VSW/SZ/BZ). The Navy and the Marine Corps are in great need of developing an effective 'in stride' clearance/breaching method to further enhance the effectiveness and viability of their littoral warfare skills. The Lemmings system has the potential to fulfill this critical need in a cost effective, reliable manner. Utilizing the Janus interactive wargaming simulation, an amphibious operation was modeled, with the amphibious landing taking place through a minefield in the littoral zones. Three scenarios of this model were developed: an amphibious landing through a minefield utilizing no clearing/breaching assets; an amphibious landing through a minefield utilizing current clearing/breaching assets; and an amphibious landing through a minefield utilizing Lemming swarms as the clearing/breaching assets. A comparative analysis of these three scenarios will be performed, examining the measures of effectiveness of landing vehicles

killed/damaged, combat power ashore at a given time, MCM assets killed, and percentage of mines neutralized.

ACCESSION NUMBER: ADA307437

http://handle.dtic.mil/100.2/ADA307437

http://edocs.nps.edu/npspubs/scholarly/theses/95Dec_Weber.pdf

Weber, Timothy R., Brad Mansager, and Carlos F. Borges. **High Resolution Modeling of Naval Mine Countermeasures**. Monterey, CA: Naval Postgraduate School, September 1996. 45p.

*ABSTRACT: This report examines a modeling approach for naval **mine** countermeasures (MCM) in the very shallow water (VSW) surf zone (SZ) and beach zone (BZ). Clearing mines in this region of the battlefield poses serious problems to an amphibious landing force. Using an accredited U.S. Army model (Janus), modifications were made to the database creating amphibious systems and threat minefields. Three scenarios were developed representing an amphibious landing of a battalion-sized force using (1) no clearing; (2) traditional (current) MCM; and (3) a new technology (Lemmings). Data was collected from each scenario to investigate the ability of Janus to represent naval MCM at the battalion landing team level of interest.*

REPORT NUMBER: NPS-MA-96-004

ACCESSION NUMBER: ADA319359

http://handle.dtic.mil/100.2/ADA319359

http://edocs.nps.edu/npspubs/scholarly/theses/NPS-MA-96-004.pdf

Wegman, Edward J., Jeffrey L. Solka, and Wendy L. Poston. **Immersive Methods for Mine Warfare**. Fairfax, VA: George Mason University, Center for Computational Statistics, April 1996. 28p.

ABSTRACT: We are developing a synthetic environment to be used in combination with real environments for the purpose of mine counter measures. Two examples of our work involve applications to land-based minefields and an application to submarine defense. In the former application, imaging is done with six spectral bands. It has been shown empirically that a sequence of images taken in six spectral bands when viewed sequentially will allow one to distinguish between real mines, partially buried real mines, decoys, other metallic objects, and other manner of debris. The image can be viewed as a 2-dimensional image with an 6-dimensional vector attached to each pixel location. We use the grand-tour technique (Wegman and Shen, 1993) to find an optimal discrimant between real mines and other objects. We then use a head-mounted display (HMD) which is semitransparent so that the real-world objects can be seen through it. After processing the scene, the suspected sites of real mines are superimposed on the visual field so that the soldier wearing the HMD is alerted to the presence of mines. The submarine application is similar. We use Crystal Eyes technology and Silicon Graphics Onyx systems in our laboratory.

ACCESSION NUMBER: ADA313514

http://handle.dtic.mil/100.2/ADA313514

Weidemann, A., et al. **Ocean Color Satellite Derived Products in Support of Diver and Special Forces Operations During OPERATION IRAQI FREEDOM.** Stennis Space Center, MS: Naval Research Laboratory, 2004. 12p.

ABSTRACT: As missions for Explosive Ordinance Disposal (EOD) units and Special Operations Forces (SOF) move closer into coastal and even "riverine" areas, there is an increased requirement for information on water clarity. This water clarity is important from the standpoint of detecting mines and minelike objects (MLO) on the bottom, in the water column, or attached to the hull of a vessel. It is also important for insersion of an EOD or SOF divers into harbors and hostile areas undetected for demining operations. In addition, as missions move at a *more demanding pace, environmental intelligence is critical in determining when and where operations are most likely to be successfull. Environmental information is now demanded on the order of minutes to hours and not days to weeks. The reality of dealing with variable environmental conditions was no where more apparent than during OPERATION IRAQI FREEDOM (OIF). During OIF there were several missions that relied on the timely delivery of water clarity information. Here we present how ocean color imagery was utilized to support EOD and SOF operations during OIF and how algorithms developed within one week were used for active operations. We also show the integration of current data into the products that allowed the warfighter to evaluate several key environmental factors.*

ACCESSION NUMBER: ADA430177

http://handle.dtic.mil/100.2/ADA430177

Weidemann, Alan D.; et al. **Using a Laser Underwater Camera Image Enhancer for Mine Warfare Applications: What is Gained?** Stennis Space Center, MS: Naval Research Laboratory, 2002. 9p.

ABSTRACT: We present preliminary results from recent test of the LUCIE 2 (Laser Underwater Camera Image Enhancer) conducted in Halifax Harbour, Nova Scotia, Canada. LUCIE 2 is a near compact laser range gated camera (25 cm in diameter, 70 cm in length, and neutrally buoyant in water) originally designed to decrease search and recovery operations under eye sage restrictions. The second generation LUCIE makes it a potential tool for MIW operations when divers are in the water identifying bottom objects. Coincident in-situ optical properties of absorption and scattering were taken to help resolve the environmental information contained in the LUCIE image. We present preliminary analysis on the performance of the system and a comparison with diver and camera identification.

ACCESSION NUMBER: ADA417137

http://handle.dtic.mil/100.2/ADA417137

Wheatley, Nicola S. **Determining Route Survey Periodicity for Mine Warfare: Investigation of Bedforms, Waves, Tides and Currents**. Monterey, CA: Naval Postgraduate School, September 2009. 105p.

ABSTRACT: To retain maritime security, an up-to-date database of mine countermeasures route surveys is essential. In 2005, the United Kingdom Hydrographic Office (UKHO) developed a GIS weighted suitability model to determine survey periodicity; allowing optimization of survey resources, increasing time and cost efficiency. The U.S. currently has no such model. Bedforms are an integral part of the survey periodicity problem. Sediment grain size, tides, currents, and wind-generated waves are influential in bedform formation. In this thesis, San Francisco Bay was chosen as a case study. To investigate if sediment properties change over time, localized grab samples for a three-year period were analyzed. The analysis showed little variability in sediment characteristics at a given location. A weighted suitability model based on the UKHO model was constructed. Three layers were developed including sediment grain size, interpolated from 174 grab samples, tidal and current data from over 50 current stations and ripple height inferred from wind generated wave height. A weighting for each layer was determined. Regions indicating the presence of bedforms were assigned a low survey periodicity, as bedforms reduced, survey periodicity was increased. High-resolution multi-beam survey data was used as a comparison and validation, this showed extremely good correlation with the model.

ACCESSION NUMBER: ADA508972

http://handle.dtic.mil/100.2/ADA508972
http://edocs.nps.edu/npspubs/scholarly/theses/2009/Sep/09Sep_Wheatley.pdf

Williams, Douglas L. **Loitering Behaviors of Autonomous Underwater Vehicles**. Monterey, CA: Naval Postgraduate School, June 2002. 84p.
ABSTRACT: In multi-vehicle mine hunting operations, it will be necessary at times for one vehicle to loiter at some point while gathering communications of data from other vehicles. The loitering behaviors of the ARIES Autonomous Underwater Vehicle have never been completely defined. The track that the vehicle chooses to maintain station while circling around one specific point for an extended period of time may be sometimes random and unpredictable, unless defined in terms of specific tracks. Simulations were run and analyzed for various conditions to record the tendencies of the vehicle during different current conditions and approach situations. The stability of the Heading Controller was then analyzed in order to predict the position where the Line of Sight Guidance algorithm becomes unstable. The data obtained through the simulations supports and explains the tendencies ARIES exhibits while circling around a loiter point.
ACCESSION NUMBER: ADA406082
http://handle.dtic.mil/100.2/ADA406082
http://edocs.nps.edu/npspubs/scholarly/theses/2002/Jun/02Jun_Williams_Douglas.pdf

Williams, K. E., et al. **Proceedings of the Ship Control Systems Symposium (5th)**, **Held at U. S. Naval Academy**, **Annapolis**, **Maryland on October 30 - November 3**, **1978**. Volume 5. Annapolis, MD: David W. Taylor Naval Ship Research and Development Center, 3 November 1978. 241p. [See also Volume 6, **ADA159086.**]
ABSTRACT: *Partial contents: A New Look at Some Old Ship Handling Problems Employing CAORF's Man-in-the-Loop Ship Simulator; Red or White Light on Ship Bridges; Ships Pilotage in Britain - Past, present, and future; Criteria Optimized by Collision Avoidance Strategies; FFG-7 Class Propulsion Controls - Design and dynamic performance; Simulation and Performance Evaluation of a Mine Countermeasures Vessel Concept; Propulsion Control Optimization of Controllable Reversible Pitch Propeller Driven Ships; A Microprocessor-Based Stabilizer Fin Control System; Use of Micro Processors in Surface Ships Bridge Control Systems; Microprocessor Software - A structured approach to control & surveillance software for marine applications; and Propulsion Control System for the 1980's.*
ACCESSION NUMBER: ADA159085

Wilson, Jeffrey V., Alexandra DeVisser, and Barbara Sugiyama. **Predicting the Mobility and Burial of Underwater Unexploded Ordnance (UXO) Using the UXO Mobility Model (ESTCP) 200417**. Lynnwood, WA: Sound and Sea Technology Inc., 2009. 165p.
ABSTRACT: One of the Navy's most long standing challenges has been conquering the mine warfare threat. As mines and mine warfare techniques evolve and become more sophisticated, so does the United States' ability to counter the threat. The United States newest technique for countering a potential mined harbor, or route, is a process known as change detection. This concept uses previous side scan sonar images of the area prior to a mining event and compares those images to a recent scan post the mining event. This allows trained technicians to identify and classify previously recognized Non-Mine, Mine-Like Bottom Objects (NOMBOs) from new shapes present on the seafloor. The object of this classification is to reduce the number of hours searching and clearing previously existing objects that are thought to be mines. If the object or shape was present before the mining event, then it can be neglected from further inspection. The challenge is having a sufficiently current scan of the area on the shelf. The environmental bottom conditions of certain locations change dramatically more often than others. It is necessary to update more frequently scans of bottom regions that present large change rates than of areas that have smaller change rates. This thesis will present a logical effort, based on known bottom

conditions, to aid in determining the rate, or periodicity, at which certain regions should be surveyed in order to have a quality scan standing by. The Resurvey Integration Model (RIM) will provide a user friendly method to efficiently and effectively predict a reasonable periodicity interval of an area to support the Navy's Mine Warfare and Meteorology and Oceanography communities. Use of this model will stand to reduce unnecessary expenditure of assets, resources and time on areas that do not require as frequent of surveys. These up to date scans will in turn aid in expediting the clearing of routes, ports and harbors after a mining event.

ACCESSION NUMBER: ADA532814
http://handle.dtic.mil/100.2/ADA532814

Withington, V. **Location and Navigation in Mine Counter-Measures Operations.** New Haven, CT: Yale University, Laboratory of Marine Physics, November 1954. 44p.
ABSTRACT: None available.
ACCESSION NUMBER: AD051756

Won, I. J. and K. Smits. **Airborne Electromagnetic Bathymetry**. Final report. NSTL Station, MS: Naval Ocean Research and Development Activity, April 1985. 23p.
ABSTRACT: An experimental airborne electromagnetic (AEM) survey was carried out in the Cape Cod Bay area to investigate the potential of extracting bathymetric information for a shallow ocean. A commercially available Dighem III AEM system was used for the survey without any significant modification. The helicopter-borne system operated at 385 Hz and 7200 Hz, both in a horizontal coplanar configuration. A concurrent ground truth survey included extensive acoustic soundings, as well as spot water conductivity measurements. Because of a lack of knowledge about the absolute system calibration figures, an acoustic-sounding calibration was made for each flight line using a small portion of AEM data to derive the zero-level signal, amplitude, and phase calibration factors for each coil pair. The interpreted bathymetric profiles show excellent agreement with corresponding acoustic depth profiles up to one (possibly more) skin depth of the source frequency. It is envisioned that with further improvements in hardware and software, the bathymetric resolution may extend beyond the skin depth. AEM data can also produce (as by-products) conductivity profiles of both seawater and bottom sediments that may find potential applications in mine warfare and offshore geotechnical engineering works.
ACCESSION NUMBER: ADA158640
http://handle.dtic.mil/100.2/ADA158640

Woodside, E. L. **Navigation in Mine Hunting**. Technical memorandum. New Haven, CT: Yale University, Laboratory of Marine Physics, October 1958. 17p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD305184
http://handle.dtic.mil/100.2/AD305184

Yoerger, E. J., et al. **Surface Forward-Scattered Acoustic Measurements and Analysis**. Final report. Stennis Space Center, MS: Naval Research Laboratory Detachment, June 1993. 5p.
ABSTRACT: A shallow water, high-frequency acoustic experiment was conducted off the coast of Panama City Florida during August 1991. Acoustic measurements of surface forward scattering, surface reverberation, and direct path intensities were made utilizing two (2) large stationary towers resting on the seafloor. Each tower was equipped with horizontal and vertical receiving arrays, while the two (2) sources were located on only one of the towers. The water bottom was 30 m deep and covered with a fine, rippled sand. The range of acoustic frequencies

varied from 20 kHz to l8O kHz. Concurrent environmental measurements including wave heights, sound velocity profiles, and sample cores were made. This paper reports on the surface forward-scattered measurements made at 24 kHz.

ACCESSION NUMBER: ADA276998

http://handle.dtic.mil/100.2/ADA276998

Young, Jeffrey L., Dennis M. Sullivan, Robert G. Olsen, Christopher L. Wagner. **Investigation of ELF Signals Associated with Mine Warfare: A University of Idaho and Acoustic Research Detachment Collaboration, Phase 2.** Idaho Falls, ID: Aerojet Nuclear Co., 2010. 148p.

Abstract: Extremely low frequency (ELF) electromagnetic signals are used by enemy combatants to detect and, subsequently, to incapacitate, by means of surface and subsurface mines, naval vessels. The questions that are being asked in this investigation are: 1) once an ELF signal is generated, how far will it propagate and still be detectable and 2) how can such signals be modeled, excited and measured? To this end, the scenario considered is one in which an ELF source of the electric or magnetic kind is located in or above water, such as a lake or ocean. This source stimulates an ELF signal that is free to propagate in the water and air, and is reflected by various material interfaces. For purposes of experimental demonstration, the investigation focuses on the scenario of ELF sources and signals in the context of Lake Pend Oreille, where the Acoustic Research Detachment (ARD, Bayview, Idaho) is located. The research program was designed with two major thrusts: Modeling and experimentation. The modeling thrust was coordinated and executed by the University of Idaho (UI), Moscow, Idaho; the experimentation thrust was coordinated and executed by ARD.

ACCESSION NUMBER: ADA529570

http://handle.dtic.mil/100.2/ADA529570

Zerr, Benoit., et al. **Proud Target Classification Based on Multiple Aspect Low Frequency Response.** SACLANTCEN Report, SR-324. [La Spezia], Italy: SACLANT Undersea Research Centre, 2001. 29p.

Abstract: The aspect dependence of the acoustic signature has been demonstrated to be an essential indicator to discriminate between man-made and natural underwater objects. A classification method has been defined using the variation with incidence angle of the acoustic waves scattered by an elastic object. As the experiment conducted in a basin on free-field cylinders produced encouraging results, more realistic acoustic measurements were conducted on natural and manufactured objects positioned on the seabed. The external shape, extracted from a reflection map reconstructed by tomography, allows selection of candidate objects for detailed analysis of their scattering properties. The resonance scattering analysis, limited to selected aspects in its original version (e.g., broadside for a cylindrical shape), has been extended to incorporate aspect-varying features. The variation with incidence of the acoustic wave diffracted by object discontinuities also has been introduced. This report discusses the results from the SACLANTCEN-NRL TASCOE (TArget Scattering in COntrolled Environment) experiment conducted in water depth of 15 meters at Marciana Marina (Elba, Italy) in October 1998. The scope of the TASCOE experiment was to acquire the acoustic response of proud objects over a broad range of azimuth angles. Data analysis shows that the aspect dependence of the acoustic waves scattered by elastic objects (ka = 2-20) allows clear discrimination between manufactured and natural objects. To provide elements of comparison with more conventional techniques, a multiple aspect automatic classification algorithm was applied to the high frequency (325 kHz) images of the same objects. The low (8kHz ricker pulse) and high frequency target responses complement each other to provide better characterization of mine-like objects.

ACCESSION NUMBER: ADA416954

http://handle.dtic.mil/100.2/ADA416954

Zinni, Jerome. **Analysis of the Divetracker Acoustical Navigation System for the NPS AUV.** Monterey, CA: Naval Postgraduate School, March 1996. 177p.

ABSTRACT: Autonomous Underwater Vehicles (AUVs) require an accurate navigation system for operating in mine fields located in the near surf zone in very shallow water. This research project examined the precision, performance characteristics, and reliability of a low cost, commercially produced, acoustical navigation system called 'DiveTracker'. The DiveTracker acoustical navigation system provides both an acoustical short baseline operator and the AUV with position data on a 1 hertz update rate. Experiments conducted on the DiveTracker system included static and dynamic tests which examined the system's ability to accurately measure distances and track a moving AUV under water.

ACCESSION NUMBER: ADA308222

http://handle.dtic.mil/100.2/ADA308222

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MINE WARFARE

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Youngblood, Norman. **The Development of Mine Warfare: A Most Murderous and Barbarous Conduct.** Westport, CT: Praeger Security International, 2006. 258p.
DKL UG 490 .Y68 2006 GENERAL

DOCUMENTS, THESES AND TECHNICAL REPORTS

1998 NDIA - 3rd Annual Expeditionary Warfare Conference. Arlington, VA: National Defense Industrial Association, Combat Survivability Division, November 1998. 460p.
ABSTRACT: This document contains the proceedings of the National Defense Industrial Association held on 2-5 Nov 98 in Panama City, Florida. Some topics discussed are mine warfare, amphibious warfare, surface warfare, naval warfare, and amphibious ships.
ACCESSION NUMBER: ADA359233
http://handle.dtic.mil/100.2/ADA359233

Anderson, Lowell Bruce and Eleanor L. Schwartz. **Net Assessment Methodologies and Critical Data Elements for Strategic and Theater Force Comparisons for Total Force Capability Assessment (TFCA)**. Volume III. A Preliminary Documentation of a Naval Model. Interim report no. 2. Alexandria, VA: Institute for Defense Analyses, International Security Assessment Division, January 1982. 338p.
ABSTRACT: The model described in this paper is an aggregated, fully automated, deterministic model of combat between two opposing forces. The Blue forces in this model can consist of aircraft carriers, escort ships, submarines, sea-based attack and defensive aircraft, and land-based defensive aircraft. The Red forces in the model can consist of surface ships, submarines, land-based attack and defensive aircraft, and ground defenses. The model is designed to simulate combat between these forces in areas in which geography can play a significant role, such as in the Mediterranean area. In particular, a goal in the design of this model was to include geographical considerations in an aggregated model--not to build a model that simulates either combat or geography (or both) in great detail. The description of the model in this paper is preliminary only in that portions of this description will be expanded in the near future in order to more thoroughly document in the model. The current status of the model is as follows: Its programming is complete. That is, an input routine, the combat interaction routines, the output routines, and the code to hold these routines together have been programmed. An unclassified and entirely hypothetical data base has been prepared, the model has been successfully run with this data base, and brief initial tests of the model have been completed.
ACCESSION NUMBER: ADA123614

Application of Oceanography to Mine Warfare. Washington, DC: Naval Oceanographic Office, 1957. 117p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0300030

Autry, Dale and Donald G. Norton. **Increasing Maritime Role of the U.S. Air Force**. Research report. Maxwell AFB, AL: Air War College, May 1989. 67p.
ABSTRACT: This paper briefly reviews the history of recent Air Force participation in maritime operations and support of the U.S. maritime strategy. It analyses Air Force capabilities in antisurface warfare, mine warfare, antiair warfare, and maritime aerial refueling. Improvements in these capabilities are suggested. The paper concludes that Air Force aircraft have a significant role in U.S. maritime operations. However, JCS force planner and theater commanders must carefully plan how to use these scarce resources to best advantage.
ACCESSION NUMBER: ADA217654
http://handle.dtic.mil/100.2/ADA217654

Bahr, James D. **Damn! The Torpedoes: Coping with Mine Warfare in the Joint Maritime Environment.** Newport, RI: Naval War College, Joint Military Operations Department, 2007. 24p.

ABSTRACT: Technological advances and the proliferation of sea mines have increased the asymmetric threat to expeditionary forces in the littorals as well as to naval forces in general. Mine countermeasures is a complex area of naval warfare and the existence of a robust capability in this area is critical to the successful execution of naval and expeditionary operations and the attainment of joint operational maneuver. The potential exists for non-state actors to acquire sea mines and subsequently employ mine warfare as a means of crippling the Navy throughout its range of military operations. The Navy has an obligation to develop and effectively employ critical operational capabilities to counter that threat. Operational commanders must recognize the capabilities at their disposal as well as their limitations to plan and make appropriate risk decisions.

ACCESSION NUMBER: ADA470742

http://handle.dtic.mil/100.2/ADA470742

Ball, James F. **Effects of Sea Mining Upon Amphibious Warfare**. Master's thesis. Fort Leavenworth, KS: Army Command and General Staff College, 5 June 1992. 148p.

ABSTRACT: This study investigates the effects of sea mining upon amphibious warfare. The methodology involves case studies of amphibious assaults conducted at Gallipoli Normandy, Wonson, and the Persian Gulf during Operation Desert Storm. The cases are examined in terms of forces involved, mining conducted, and the effect the mining and mine countermeasures had upon the achievement of surprise in the assault. The study attempts to determine if the determining factor is the level of mine technology, or the size of the forces involved. It emphasizes the importance of rapid and complete mine countermeasures to the achievement of surprise in the amphibious assault. Based upon the four cases studied, the determinant appears to be force levels. At Normandy where levels were adequate, the operation was successful. At Gallipoli and Wonsan the results were either failure or inconclusive. The Persian Gulf study points out that failure would have been the likely result. A recommendation to prevent further deterioration of the mine countermeasures force is presented.

ACCESSION NUMBER: ADA255564

http://handle.dtic.mil/100.2/ADA255564

Bennett, R. H. **Seabed-Structure Interaction: Workshop Report and Recommendations for Future Research Held in Metairie**, **Louisiana on 5-6 November 1991**. Final report. Stennis Space Center, MS: Naval Oceanographic and Atmospheric Research Laboratory, February 1992. 28p.

ABSTRACT: Intrinsic to the topic of Seabed-Structure Interaction (S-SI) of objects coupled with the seafloor is the dynamics of the 'system.' The dynamics involve environmental forcing of the object and the seabed, the fundamental properties of the geological material, the size and shape of the object, and the time-dependent processes associated with the coupling of the water column, seabed, and the object. Thus, the most crucial S-Sl research problems to address in the Coastal Benthic Boundary Layer Special Research Project (SRP) should focus on the dynamics and time-dependent processes affecting objects coupled to the sea floor. The research efforts should include a range of scales from micro to macro but largely focused on the dynamics and processes in proximity to the object rather than broad scale geological oceanographic processes. Much is to be gained by interdisciplinary research well focused on specific S-SI phenomena. Acoustics, Sediments, Mines.

REPORT NUMBER: NOARL-PR-92-016-360

ACCESSION NUMBER: ADA250692
http://handle.dtic.mil/100.2/ADA250692

Beringer, R. ; Robinson, C. ; Mertz, M. C. **Radar Studies of Mine Splashes in OPERATION MUD.** New Haven, CT: Yale University, Laboratory of Marine Physics, 1952. 35p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0024876
http://handle.dtic.mil/100.2/AD024876

Blood, Christopher. G. **Analyses of Battle Casualties by Weapon Type Aboard U.S. Navy Warships.** Final report. San Diego, CA: Naval Health Research Center, February 1991. 24p.
ABSTRACT: The number of casualties was determined for 513 incidents involving U.S. Navy warships sunk or damaged during World War II. Ship type and weapon were significant factors in determining the numbers of wounded and killed. Multiple weapon attacks and kamikazes yielded more WIA than other weapon types. Multiple weapons and torpedos resulted in a higher incidence of KIA than other weapons. Penetrating wounds and burns were the most prominent injury types. Kamikaze attacks yielded significantly more burns than incidents involving bombs, gunfire, torpedoes, mines, and multiple weapons. Mine explosions were responsible for more strains, sprains, and dislocations than the other weapon types. Torpedo attacks were more likely to sink the vessel than other weapon attacks. Shipboard battle injuries, casualties, ship types wounded-in-action, killed-in-action, weapon effects.
ACCESSION NUMBER: ADA252892
http://handle.dtic.mil/100.2/ADA252892

Blumenberg, Michael A. **Analysis of Explosive Ordnance Disposal Support Facilities Aboard the AVENGER (MCM-1) Class Ships**. Washington, DC: Naval Sea Systems Command, December 1991. 96p.
ABSTRACT: The United States Navy's AVENGER Class mine countermeasures ships are designed with facilities to support an explosive ordnance disposal detachment. However, the design and use of these facilities has not been endorsed by either the United States Navy's explosive ordnance disposal community, mine warfare community or crews of the AVENGER Class ships. This research paper investigates the above circumstances by discussing the missions and capabilities of an explosive ordnance disposal detachment and the MCM-1 Class ships in mine countermeasures operations. This study will conclude by recommending a definitive relationship between explosive ordnance disposal detachments and the AVENGER Class ships for mine countermeasures operations, including recommendations for actions necessary to achieve this relationship.
ACCESSION NUMBER: ADA331928
http://handle.dtic.mil/100.2/ADA331928

Borden, Steven A. **Mine Countermeasures: A Comparative Analysis of US Navy Mine Countermeasures 1999 vs. 2020**. Carlisle Barracks, PA: Army War College, 10 April 2000. 41p.
ABSTRACT: The intent of this project is to complete a comparative analysis of current US Navy Mine Countermeasures capabilities versus projected capabilities in 2020. Following a historical background, this paper will review the current force structure, its capabilities and how this force operates. It will describe proposed changes to the force and alternative concepts of operation for the 2020 timeframe. Additionally, it will relate the impact of future mine

countermeasures capabilities to the ability of naval forces to conduct operational maneuver from the sea and the impact to strategic sealift timelines.

ACCESSION NUMBER: ADA377403

http://handle.dtic.mil/100.2/ADA377403

Bottoms, Albert M., Ellis A. Johnson, Barbara Honegger (eds.) **Proceedings of the Technology and the Mine Problem Symposium**, **18-21 November 1996**, **Naval Postgraduate School**, **Monterey**, **California**. 2 volumes. Monterey, CA: Naval Postgraduate School, November 1996.

ABSTRACT: Major topics of this symposium are (1) The Challenge, (2) Operational Requirements and Perspectives, (3) Operational Environments and Threats, (4) Landmines and Humanitarian Demining, (5) Progress in Autonomous Systems for Mine Warfare, and (6) Countering Mines on Land.

ACCESSION NUMBER: v. 1 -- ADA326694, **v. 2 – ADA327338**

http://handle.dtic.mil/100.2/ADA326694

http://handle.dtic.mil/100.2/ADA327338

Cashman, T.M. **Striking First...Mine Warfare Goes on the Offensive**. Newport, RI: Naval War College, Joint Military Operations Department, 2002. 18p.

ABSTRACT: The indiscriminate laying of sea mines in international waters is an act of war waged by terrorist groups and non-state actors. If the United States is going to successfully counter this act of overt aggression and be successful in future conflicts which involve the illegal use of mines, it must deter the belligerent through political, diplomatic, and if necessary, physical force. History is replete with examples of the effective use of sea mines to deter, alter or counter enemy forces. In today's environment, mines have been used more as an act of terror than a legal weapon of war. Historically, the U.S. Navy has shown a reluctance to adequately fund and appreciate the value of an aggressive countermine force. As a result, U.S. and coalition forces have been needlessly subjected to higher risks, delayed or altered battle plans and operationally limited in their course of action. Once mines are placed in the water the belligerents have gained the strategic, operational and tactical upper hand. From a time, space and force standpoint, the combination of U.S. mine countermeasures and allied forces is marginally sufficient to counter this threat and enable the naval commander the ability to effectively "control the sea." This should be the siren call to all naval commanders! Unless the United States leads the way in treating the indiscriminate laying of mines in international waters as an act of war, the United States and its allies will not be able to project forces ashore or control the seas without encountering considerable risks. The time is now to set the stage for new international laws regarding mine warfare, redefine rules of engagement, break down inter-service politics, educate the media, and build coalition support. The U.S. needs to muster the political will to strike first or suffer the consequences from a military and economic standpoint.

ACCESSION NUMBER: ADA405922

http://handle.dtic.mil/100.2/ADA405922

Clem, Travis. **Oceanographic Effects on Maritime Threats: Mines and Oil Spills in the Strait of Hormuz.** Monterey, CA: Naval Postgraduate School, 2007. 104p.

Abstract: *The Strait of Hormuz is a unique waterway vital to world commerce; as such, it is of military importance as well. The strait is narrow and has turbulent currents that change in intensity and direction due to the reverse estuarine flow of the Persian Gulf. On the border between extratropical and monsoonal atmospheric synoptic influences, the wind direction and intensity are dependent on time of year, which side of the strait due to terrain, and time of day due to land/sea breeze cycles. Utilization of model field inputs (from near real-time models) to tactical decision aids greatly enhances the information output by those aids. Using the examples of drifting mines* *and oil spills, the utility of these model fields is shown when compared to climatology inputs. OILMAP, the oil dispersion model developed at Applied Science Associates, is used in this study to demonstrate how the behavior of an oil spill reacts with model field inputs for surface winds and currents from the Naval Oceanographic Office and the Fleet Numerical Meteorology and Oceanography Center, followed by comparative analysis between climatology inputs. Drift mine behavior is analyzed utilizing a simple Lagrangian drift model with model field inputs compared with climatology inputs. The results from the comparisons show that the variable nature of the wind/current direction and speed through the strait is impossible to capture using climatology inputs. Winds less than 5 m/s are not a factor in the movement of an oil slick; even compared to the slowest of currents at ~10-15 cm/s. It is determined that the tidal nature of the currents through the strait, combined with variable strength of the winds, make prediction of oil slick or mine drift track unrealistic using climatology data. Therefore, using operational, near real-time environmental data is necessary for information superiority.*

ACCESSION NUMBER: ADA467183

http://handle.dtic.mil/100.2/ADA467183

http://edocs.nps.edu/npspubs/scholarly/theses/2007/Mar/07Mar_Clem.pdf

Cochran, Bryan M. **Mine Warfare: The Joint Force Commander's Achilles Heel**. Newport, RI: Naval War College, Joint Military Operations Department, 2004. 32p.

ABSTRACT: *Mine Warfare (MIW) has been a traditional weakness of the U.S. Navy. The affordability of mines, their destructive power and wide proliferation coupled with the requirement for the U.S. Navy to operate in the littorals requires drastic improvements to U.S. Mine Warfare. To support operational timelines, forward deployed naval forces need Mine Countermeasures systems resident within Strike Groups to counter enemy mine laying activities. Additionally, the Navy needs to transform its culture and mainstream the full spectrum of MIW to include naval mining and countermine warfare capabilities. Only then will Joint Force Commanders be able to control the battlespace, operate unfettered in littoral areas, and pass freely through critical choke points to execute operational plans. The U.S. Navy needs to transform its culture and mainstream MIW through doctrine, training, education, and leadership. In addition to elevating MIW to a core war fighting function with an established MIW Commander, formalizing MIW doctrine, establishing a base level of knowledge among the officer corps, and incorporating realistic MIW Strike Group work-ups, the Navy must also ensure that MIW assignments are career enhancing and attract top performers across the spectrum of officer communities. A MIW force, capable of overcoming the vulnerabilities exposed by the Gulf War, requires the synergy of technological advancements and culture change. The appendixes contain a chart of U.S. ship casualties by weapon type for 1950 to the present, a chart of mine warfare components, and an annotated bibliography of organic mine countermeasure systems*

ACCESSION NUMBER: ADA422828

http://handle.dtic.mil/100.2/ADA422828

Cornish, Gregory J. **U.S. Naval Mine Warfare Strategy: Analysis of the Way Ahead.** Carlisle Barracks, PA: Army War College, 2003. 44p.

ABSTRACT: The history of naval mine warfare in wars and conflicts has taught the United States Navy many valuable lessons. Unfortunately, many of these lessons learned have, for the most part, been painfully relearned in successive wars and conflicts. Compared to more glamorous naval mission areas such as strike warfare, mine warfare has usually been under funded and had difficulty maintaining momentum toward improving fleet capabilities in this vital mission area. Sea mines today remain a serious threat to U.S. strategic interests in key regions of the world. The United States Navy today is embarked on an ambitious plan to improve and transform its mine countermeasures capabilities. This paper discusses common themes and lessons learned in past wars and conflicts, depicts the current mine threat, discusses current

force structure, analyzes the Chief of Naval Operations Sea Power 21 vision for improving long term mine warfare capabilities and provides recommendations for improving near term readiness.
ACCESSION NUMBER: ADA414973
http://handle.dtic.mil/100.2/ADA414973

Crist, David B. **Joint Special Operations in Support of Earnest Will.** Washington, DC: National Defense University, Institute for National Strategic Studies, 2002. 9p.
ABSTRACT: On the night of July 23, 1987, there was news of an unusual amount of naval activity around the small Iranian island of Farsi in the northern Persian Gulf. Rear Admiral Harold Bernsen, commander of Middle East Force, found the reports disquieting. The first convoy of Operation Earnest Will was due to arrive in a few hours. It consisted of two oil tankers accompanied by three naval warships. The next morning, twenty miles west of Farsi, Captain Frank Seitz of SS Bridgetown heard a sound like "a 500-ton hammer hit us up forward. "The ship had struck one of nine contact mines laid by the Iranian vessel Sirjan on the previous night. It blew an eight-and-a-hall by ten-foot hole in the tanker halting activity in the northern Gulf to the embarrassment of Washington. The United States launched a unique effort in response forming a joint special operations task force based aboard two converted oil barges. For more than a year this force engaged in a daily struggle with Iranian small boats and mine layers for control of the sealanes in the channelized area north of Bahrain. In every respect this operation was a remarkable effort and a blue-print for crafting unconventional responses to unconventional threats.
ACCESSION NUMBER: ADA403506
http://handle.dtic.mil/100.2/ADA403506

Deere, Chris. **No "Silver Bullet" in Mine Countermeasures – at the Operational Level, Plan Accordingly**. Toronto, Ontario:Canadian Forces College, 2005.
ABSTRACT: The production and proliferation of sea mines in today's world is unprecedented with global mine stocks estimated to be in excess of 350,000 varying in type and complexity. Mines have played a major and influential role in nearly all international Maritime Operations, during and since WWI, and will continue to do so in the future. Furthermore, mines are becoming more and more a weapon of choice including potential exploitation in an asymmetric domain. Since 1950, three US Navy ships have been damaged by air attacks, missiles or torpedoes; a startling 14 have been damaged or sunk by mines. No other threat denies sea control and freedom of action so cost effectively to maritime combatants, both surface and sub surface, than the threat from sea mines especially in littoral waters. This paper argues that at the Operational Level in maritime planning, the impact of mines and the realities of modern mine countermeasures are not accurately or appropriately factored into preparing or executing a campaign plan. Using two post Second-World War mining campaigns, the paper examines lessons learned as they pertain to Operational Level joint and maritime campaign planning. The paper concludes that Mine Countermeasures is a deliberate, prolonged, and complex process, which is not well understood by operational planning staffs, and is often discounted during campaign planning and execution. In order to maintain command of the sea and minimize the threat to shipping from mines, the operational planners need to better understand both offensive and defensive MCM and factor it, realistically, into the overall campaign from the outset.
http://www.cfc.forces.gc.ca/papers/amsc/amsc8/deere.pdf

Denning, Gary M. **Mine Countermeasures: Tomorrow's Operations -- Today's Implications**. Final report. Newport, RI: Naval War College, February 1997. 23p.
ABSTRACT: Among the most cost effective weapons available to Third World nations are naval mines. Naval mines provide a small navy with an asymmetrical means to counter a much

larger and more capable navy. As the United States discerned during Desert Storm, naval mines, more than any other weapon encountered, had the potential to deny access to U.S. vital objectives, block U.S. naval power projection, and jeopardize the steady flow of sustainment. The U.S. Naval Services and its MCM force took away several lessons learned from Desert Storm. They have since responded to these lessons by restructuring MCM organization and accelerating its research and development for technological improvements. While these are key takeaways, it remains to be seen whether or not the Naval Services learned the most significant lesson: MCM operations will ultimately fail unless considered as a component of the overall campaign or operational plan. The combatant commander has the ability to correct the greatest MCM deficiency of all right now. His greatest asset to minimize the mine threat is his own operational judgment. If naval expeditionary forces are to successfully dominate tomorrow's littorals, today's combatant commander must integrate MCM operations into his standing plans.

ACCESSION NUMBER: ADA325248

http://handle.dtic.mil/100.2/ADA325248

Donohue, John J. and Louis E. Garrison. **An Evaluation of Mine Behavior Observations in Four Test Areas**. Rhode Island University, Kingston, Narragansett Marine Laboratory, August 1954.

ABSTRACT: None Available.

ACCESSION NUMBER: AD0057092

Duncan, Robert C. **America's Use of Sea Mines**. White Oak, MD: Naval Ordnance Laboratory, January 1962. 182p.

ABSTRACT: This volume is devoted to the history and use by the United States of one of the Navy's least spectacular and most effective weapons. The effectiveness of the submarine mine has not decreased with the coming of the space age. So long as cargo ships cross the sea, this spectacular weapon will remain a major factor in control of the approaches to harbors, and the shallow straits between seas. Robert Duncan has devoted most of his adult life to the generation and augmentation of competence in the application of growing science to the design, production, and use of mines for the U.S. Navy. He joined the staff of the Naval Ordnance Laboratory before it was known by that name, but in time to capitalize on the experience of the Navy with mines in World War I. He provided the technical leadership which was an important factor in keeping the art and science of mining alive in the Navy in the days of the depression. By so doing, he provided a basis for a hundredfold expansion of the Navy's effort previous to and during World War II. The hundreds of technical people who had the privilege of joining in this effort under Dr. Duncan's leadership will be happy to see this accurate and factual record of achievement. The experience recorded between these covers will serve as a guide to those still engaged in the development of this type of weapon, and the achievements made during World War II will be an inspiration to any who might be responsible for again expanding our national effort in mining, should the occasion arise.

ACCESSION NUMBER: ADA061490
DKL V 856.5 .U3 D8 1962 GENERAL

Eaton, D. **Canadian Underwater Mine Apparatus: Unmanned Performance Validation of the Second Prototype Second Stage Regulator.** DCIEM technical report no. 89-TR-44. Downsview (Ontario): Defence and Civil Institute of Environmental Medicine, c1989. 15p.

ABSTRACT: The Canadian underwater mine apparatus (CUMA) provides life support for a mine-countermeasures diver to depths of 80 m of seawater (msw). The design of the CUMA produces a breathing gas with constant oxygen partial pressure by mixing pure oxygen with a diluent, either nitrogen for diving to depths of 55 msw or helium for depths of 80 msw. A reliability test of the gas-mixing circuit, two manned evaluations of the CUMA, and a field trial proved that

the gas-mixing circuit worked as desired. However, a crucial component in the diluent circuit, the second stage regulator, needed technical improvements to increase its compatibility with saltwater and helium. Changes were made and a test protocol was designed to evaluate the output characteristics, and to some extent the reliability, of the new regulator. This document describes the results of a series of tests performed to establish the linearity of the regulator, the coefficients of the regression line, and the repeatability of the relationship.
ACCESSION NUMBER: MIC-92-06167

Eaton, D. J. and S. A. McDougall. **Project Review of the Experimental Diving Unit**. Semi-annual report November 1993-April 1994. Downsview (Ontario): Defence and Civil Institute of Environmental Medicine, June 1994. 46p.
ABSTRACT: Two projects in EDU, development of a freeze-proof regulator and decompression tables for the Canadian Underwater Mine-countermeasures Apparatus (CUMA), continue to occupy the majority of the unit's time. Regulator development involved iterative testing and modification of two prototypes while two, four-week dive series were completed to add 173 more human exposures to the data base required to validate the CUMA decompression model and tables. The development of an integrated system of equipment for mine-countermeasures diving integrated well with the CUMA decompression table validation. During each dive series components, such as new weight harness prototypes or dry suit samples, were included in the dives so that development could continue in parallel with the table validation. Another project which dovetailed well with the CUMA decompression work was the development of the hand heating system under the Clearance Diver's Supplementary Heat project. Prototypes were evaluated during the CUMA decompression dives. This project has expanded to include whole body heating and electric suits for this purpose were obtained to compare their performance against the standard hot water suit.
ACCESSION NUMBER: ADA284183
http://handle.dtic.mil/100.2/ADA284183

Eddy, M. F., H. D. Kribs, and M. B. Cowen. **Cognitive and Behavioral Task Implications for Three-Dimensional Displays Used in Combat Information/Direction Centers.** Pensacola, FL: Instructional Science and Development, Inc., March 1999. 39p.
ABSTRACT: This report discusses an investigation to determine which tactical information should be displayed in three dimensions (3-D), as visualized data that would be beneficial to the warfighter's understanding of the battlespace. A cognitive task analysis was conducted using warfighting personnel from Surface Warfare Officer's School (SWOS), Joint Maritime Command Information System (JMCIS) instructors at Navy Technical Training Center, Corry Station, and participants at the 'All Service Combat Identification and Evaluation Team, 1997' combat training exercise. Our task analysis found that a 3-D display could enhance situation awareness by providing a succinct, comprehensive, and readily discernable presentation of the common tactical picture. 3-D displays could aid tactical decisionmakers in three general cognitive/perceptual areas: (1) assessing the force structure of friends, neutrals, possible adversaries, and noncombatants, (2) anticipating possible future actions based upon capabilities, historical precedent, and current political climate, and (3) refining and rehearsing contingency plans based on an assessment of the possible threat. Our analysis examined these processes and determined that a 3-D display could provide enhancement in submarine and mine location/interdiction, amphibious assault/land support, and air warfare planning and execution.
REPORT NUMBER: TR-1792
ACCESSION NUMBER: ADA361719
http://handle.dtic.mil/100.2/ADA361719

Edlow, Sabrina R. **Naval Mining and Arms Control.** Alexandria, VA: Center for Naval Analyses, April 1997. 10p.

ABSTRACT: The challenge for U.S. arms-control policy is to recognize and balance competing national security, foreign policy, and economic interests. In the case of naval mines, the U.S. economy and defense industrial base concerns are essentially nil. Thus, control of naval mines should focus on the balance between national security and foreign policy. Then, because of the indiscriminate nature of naval mines, like that of land mines, several additional issues require attention. Can technology offer a discriminate or acceptable solution. Or would we prefer to have fewer mines available to adversaries that we would have to counter. Could naval mines serve as an arms control bargaining chip.

REPORT NUMBER: CNA-CIM-507
ACCESSION NUMBER: ADA362435
http://handle.dtic.mil/100.2/ADA362435

_______. **U.S. Employment of Naval Mines: A Chronology**. Alexandria, VA: Center for Naval Analyses, April 1997. 15p.

ABSTRACT: During this century, the United States has used naval mines both effectively and ineffectively. Naval mines first evolved as a weapon during the Revolutionary War. The United States employed them during both World Wars, most notably the North Sea Barrage in WWI and Operations Starvation in WWII. In such 'go-for-bust' global wars against peer unified rivals, naval mines significantly shaped events. The Cold war brought a different type of warfare. This report provides information about naval mines and U.S. mining operations in the Revolutionary War, Civil War, WWI, WWII, the Korean War, Vietnam, Nicaragua and the Persian Gulf War.

REPORT NUMBER: CIM 506
ACCESSION NUMBER: ADA362483
http://handle.dtic.mil/100.2/ADA362483
http://www.cna.org/documents/9505060000.pdf

Eidson, Edward W. **Breaking Through the Wall: A Realistic Perspective of the Very Shallow Water (VSW) and Surf Zone (SZ) Mine Threat**. Newport, RI: Naval War College, 8 February 2000. 30p.

ABSTRACT: The ability to project power ashore through amphibious operations is a Navy and Marine Corps core competency that must be maintained in order to allow global response as delineated in the National Security Strategy. Because of the VSW/SZ mine threat, the technological inability to defeat it, amphibious doctrinal rigidity, and 'zero acceptable casualties' mentality, the United States has become incapable of projecting power ashore. This limits the available options to the Operational Commander and neutralizes the advantages of strategic and operational mobility inherent in Naval forces. The proliferation and technological simplicity of mines has made VSW/SZ mining an economic flexible deterrent option, against amphibious assault, for third world nations incapable of challenging the United States conventionally. This, coupled with the inability to technologically defeat the threat, necessitates a means of threat mitigation and a flexible approach if the United States intends to maintain the ability to conduct opposed amphibious operations. This impediment has resulted from the rigidity of amphibious doctrine and an aversion to casualties constraining the Operational Commander and relinquishing the initiative to potential adversaries. Technological advances in mine detection and over-the-horizon amphibious vehicles, doctrinal flexibility, and planning at the appropriate level, when coupled with the tenants of Operational Maneuver from the Sea, will provide a means of mitigating the threat to an acceptable level.

ACCESSION NUMBER: ADA378494
http://handle.dtic.mil/100.2/ADA378494

Elischer, P. and J. Howe. **Australia's Shock Testing Capability.** Canberra (Australia): Defence Science and Technology Organisation, 11 February 1993. 9p. [Proceedings from the Institution of Engineers, Australia Dynamic Loading in Manufacturing and Service Conference Held in Melbourne, Victoria on 9-11 February 1990.]

ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP), minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program and the various research tasks undertaken by DSTO. This paper presents an overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water.

_______. **Dynamic Loading in Manufacturing and Service: Australia's Shock Testing Capability.** Ascot Vale (Australia): Materials Research Laboratories, 11 February 1993. 9p.

ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP) minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program and the various research tasks undertaken by DSTO. An overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water is presented.

ACCESSION NUMBER: ADA268334

http://handle.dtic.mil/100.2/ADA268334

Erickson, Andrew S., Lyle J. Goldstein and William S. Murray. **Chinese Mine Warfare: A PLA Navy Assassin's Mace Capability**. Newport, RI: Naval War College, Center for Naval Warfare Studies, 2009. 100p.

Abstract: After a lengthy hiatus -- lasting nearly six centuries -- China is reemerging as a maritime power, this time with an emphasis on undersea warfare. Between 1996 and 2006, the Chinese navy took delivery of more than thirty submarines. These vessels include two new classes of nuclear submarines -- the advanced Song-class diesel submarines and the Yuan class of diesel boats -- which, according to some reports, was a surprise for U.S. intelligence. Above and beyond this ambitious naval construction program, the People's Republic of China (PRC) received during 2005-06 an additional eight formidable Kilo-class submarines (and associated weaponry), which were purchased in 2002, to add to the four it already operated. A new nuclear submarine base on Hainan Island may well herald a new era of more extended Chinese submarine operations. Much discussion among East Asian security analysts now centers on Beijing's potential development and deployment of aircraft carriers. However, at least in the near term, this discussion amounts to a red herring. For the foreseeable future, China does not seek to "rule the waves" writ large but rather is seeking the much narrower and more realizable objective of dominating the East Asian littoral. While photos of a first Chinese carrier will no doubt cause a stir, the Chinese navy has in recent times focused much attention upon a decidedly more mundane and nonphotogenic arena of naval warfare: sea mines. This focus has, in combination with other asymmetric forms of naval warfare, had a significant impact on the balance of power in

East Asia. People's Liberation Army Navy (PLAN) strategists contend that sea mines are "easy to lay and difficult to sweep; their concealment potential is strong; their destructive power is high; and the threat value is long-lasting."

ACCESSION NUMBER: ADA519027

http://handle.dtic.mil/100.2/ADA519027

http://www.usnwc.edu/Research---Gaming/China-Maritime-Studies-Institute/Publications/documents/CMS3_Mine-Warfare.aspx

Evangelista, Rickson E. **Mine Warfare: Lessons Learned and Forgotten**. Newport, RI: Naval War College, 2008. 23p.

ABSTRACT: As the focus of maritime operations shifts from the open ocean to the littoral environment, the increasing importance of mine warfare (MIW) must be recognized and accounted for. The Joint Task Force Commander must have a thorough understanding of and appreciation for the important role MIW can play at the operational level of war. This analysis focuses on four battles/operations that involved mine countermeasures: The Battle of Mobile Bay, the amphibious landings at Inchon and Wonsan, and the planned amphibious landing into Kuwait. If the U.S. Navy is to be adequately prepared to face the growing mine warfare challenge, it must change its disinterested mind-set towards MIW Planners must appreciate how mine countermeasures can be used to shape the battlefield and facilitate operational maneuvers Furthermore, planners must understand mine warfare's limitations and the impact it can have on factor-time. Finally, operational commanders must understand the important role intelligence can play in support of mine warfare operations.

ACCESSION NUMBER: ADA268334

http://handle.dtic.mil/100.2/ADA484287

Fanta, Peter J. **Sea Mines at the Operational Level of War**. Final report. Newport, RI: Naval War College, 13 February 1995. 21p.

ABSTRACT: Sea mines represent a significant challenge to the operational commander both in operational planning and execution. Mining affects all levels of warfare: strategic, operational and tactical. Through historical example, the impact of mines at the Operational level of war can be readily demonstrated. Analyzing lessons learned shows how mines can affect operational maneuver, operational tempo, surprise, and security. Additionally, since mines are inexpensive, plentiful, and can be easily placed, planning for mine countermeasure operations is a requirement for every operation, large or small. Using historical examples for a framework, a conceptual model to evaluate the need for mine countermeasures planning can be created, allowing for advance planning and for tailoring operations to better meet the threat.

ACCESSION NUMBER: ADA293702

http://handle.dtic.mil/100.2/ADA293702

Fowler, Robert W. **Mine Countermeasures at the Operational Level of War.** Final report. Newport, RI: Naval War College, Department of Operations, 12 November 1993. 32p.
ABSTRACT: This paper examines the complex problems and difficulties facing an operational commander when conducting operations in a mine threat environment. A discussion of mine warfare history, operational considerations, and today's mine countermeasure assets as well as a hypothetical situation that a commander may actually be faced with in today's global crisis-oriented climate is considered. The ability of the U.S. Navy to accomplish its primary strategic goal of Power Projection in a mine-threat environment is extremely difficult and limited. The panacea for present day MCM operations is recognition of the threat, knowledge of own capabilities, fleet training, and frugal management of MCM assets.
ACCESSION NUMBER: ADA265300
http://handle.dtic.mil/100.2/ADA265300

French, R. E. **Case History of Pressure Detector WOX-6A**. Technical report. Indianapolis, IN: Naval Avionics Facility, April 1964. 9p.
ABSTRACT: The report reviews problems and accomplishments relative to the production engineering and fabrication of evaluation models of pressure detector which functions as a signal sensing unit for a mine firing mechanism.
REPORT NUMBER: NAFI-TR-416
ACCESSION NUMBER: AD0855537

Gaffney, William Alan. **Policy Considerations for the Improvement of the United States Navy Mine Warfare Capability**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1973. 60p.
ABSTRACT: The general purpose of the report is to indicate the importance of the role of mine warfare in supporting the nation's defense policy and, ultimately, the nation's political policy. The basic problem, a lack of attention and emphasis of mine warfare on the part of persons in positions of decision in the defense establishment, is treated in the opening sections as a prelude to describe the need for such a paper. Future scenarios for mine warfare employment are developed to illustrate the importance of the mine and some of the possible areas where it may be used. This line of thought is expanded through a discussion of the weapon's value as a deterrent and as a defensive weapon. Finally, a design is offered for a future Mine Force with a much broader range of capabilities and exposure to Fleet activities.
ACCESSION NUMBER: AD0764498

Gallagher, Daniel I. **Sea Lane Defense: Japanese Capabilities and Imperatives**. Master's thesis. Monterey, CA: Naval Postgraduate School, December 1987. 160p.
ABSTRACT: Japan has significant capabilities to protect its sealanes out to 1000 nautical miles to the south of its main ports. By concentrating military expenditures on forces to improve air defense, strait control, and convoy operations, Japan could have a credible defense, even in the worst possibility: global war and a Soviet attack. The Japanese should concentrate on improving the air defense of Japan and the ocean between Iwo Jima and Okinawa, increasing their stockpile of mines and their mine warfare forces, and increasing the numbers of their long-range maritime patrol aircraft and surface escort ships. These improvements all maintain the defensive nature of Japanese forces and are attainable within the next decade.
ACCESSION NUMBER: ADA189173

Gambiez, Gerard **Should We Fear Mine Warfare**. Study project. Carlisle Barracks, PA: Army War College, 30 March 1989. 44p.
ABSTRACT: Mines are weapons. Thanks to the improvements allowed by electronics they become more and more efficient and cost effective. On land as well as at sea, they would be widely used at theater level by all belligerents in all types of conflicts. Unfortunately improvements in mine countermeasures are more difficult to realize and to use on the field. The nations of the free world should increase their efforts in the domain of those countermeasure systems, or they risk being the first victims of the increasing advances in mines and mine delivery systems. The problem is as difficult as urgent.
ACCESSION NUMBER: ADA209180
http://handle.dtic.mil/100.2/ADA209180

Game, Carlos V. **Defensive Minefield Planning**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1989. 79p.
ABSTRACT: This thesis is concerned with the problem of constructing an optimal minefield for inflicting casualties to a naval force attempting to penetrate the field. A microcomputer based simulation program dealing with this problem is presented and permits the user to select various mine characteristics (charge weight, depth, sensitivity), number of mines, number of transitting ships and navigational error.
ACCESSION NUMBER: ADA215142
http://handle.dtic.mil/100.2/ADA215142

The German KM Naval Mine Series. Technical report. Naval Technical Mission in Europe. September 1945. 7p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953476

Gilbert, Jason A. **Combined Mine Countermeasures Force: A Unified Commander-in-Chief's Answer to the Mine Threat**. Newport, RI: Naval War College, Joint Military Operations Department, 5 February 2001. 26p.
ABSTRACT: The threat of mines presents a Unified commander-in-Chief (CINC) with problems affecting the time-space-force aspects of his command. Further complicating this matter, is the U.S. Navy's inability to adequately address the mine threat problem unilaterally. History demonstrates that the U.S. Navy's inability to maintain a mine countermeasures (MCM) force sufficiently large enough and technologically advanced enough has been nominally off-set by the strengths of a combined MCM force. Joint Doctrine supports the forming of alliances and coalitions, whenever possible, in order to integrate the capabilities of other nations and to promote regional stability. The complexities associated with combined forces are simplified by the characteristics and political appeal of MCM, making it attractive to the CINC and potential partner-nations. Given that mines will remain a threat complicating a CINC's ability to effectively direct the operations of his forces, and that there is a legitimate need to solve the U.S. Navy's MCM deficiencies, a CINC will be able to train as he would fight and positively influence regional stability by planning for a combined MCM force.
ACCESSION NUMBER: ADA390327
http://handle.dtic.mil/100.2/ADA390327

Gish, Oliver H. **Protection Against Influence Mines**. Washington, DC: Department of the Navy, February 1980. Patent. 5p.
ABSTRACT: Apparatus for decreasing the intensity of cosmic rays at a selected dince beneath a relatively empty displacement volume in an otherwise uniformly loaded ship floating on a body

of water comprising in combination, a ship having a relatively empty displacement volume, and means for establishing in vertical alinement with said volume a charged particle deflecting field having a strength and configuration effective to divert from a region at said selected distance directly beneath said volume a major fraction of the charged particles which would be prevented from reaching said region by absorption in water displaced by said volume.
REPORT NUMBER: PATENT: 4,186, 681
http://www.uspto.gov/patft/

Gluth, Joseph. V. **Is the Navy's Mine Warfare Posture Bankrupt**. Final report. Newport, RI: Naval War College, Department of Operations, June 1991. 33p.
ABSTRACT: This paper addresses the Navy' posture on mine warfare (MIW). The purpose is to examine the perception that the Navy's MIW capabilities are inadequate and that appropriate corrective actions are not being taken. Despite MIW's lack of strong congressional sponsorship enjoyed by other warfare specialties, the Navy has developed a highly capable and responsive force of mine countermeasures (MCM) helicopters and ocean-going vessels, as well as the capability of providing limited MCM through the Craft of Opportunity Program (COOP). Even though a high proportion of MCM capability resides in the Naval Reserve Force, the channel survey and conditioning function they perform contributes directly to the readiness posture of the active Navy. The Navy's MIW posture is not bankrupt, but is vital and forward looking. Recommendations provided include expanding the COOP, protecting the Reserve MCM role, and institutionalizing the benefit of MIW experience among the officer corps.
ACCESSION NUMBER: ADA236976
http://handle.dtic.mil/100.2/ADA236976

Green, Daniel M. **Monitoring Technology Proliferation: An Open Source Methodology for Generating Proliferation Intelligence.** Master's thesis. Monterey, CA: Naval Postgraduate School, December 1993. 108p.
ABSTRACT: This thesis develops a methodology to monitor technology proliferation. It is designed to provide proliferation intelligence on specific threat technologies and can be used to augment export controls or enhance counter proliferation initiatives. A high-tech component used to upgrade underwater mines is the subject of the case study developed in this thesis. This technology monitoring method exploits the exponentially expanding volume of open source information occurring as a result of the information revolution.
ACCESSION NUMBER: ADA277295
http://handle.dtic.mil/100.2/ADA277295

Greer, William L. 1972 **Mining of Haiphong Harbor: A Case Study in Naval Mining and Diplomacy**. Alexandria, VA: Institute for Defense Analyses, April 1997. 21p.
ABSTRACT: This paper summarizes the events leading to the U.S. mining of Haiphong Harbor in 1972, near the end of the War in Vietnam. It uses the lessons learned there to examine the implications of the use of naval mining as an element of coercive diplomacy in future conflicts.
REPORT NUMBER: IDA-D-2056
ACCESSION NUMBER: ADA355037
http://handle.dtic.mil/100.2/ADA355037

Greer, William L. and James C. Bartholomew. **Psychological Aspects of Mine Warfare**. Alexandria, VA: Center for Naval Analyses, Naval Studies Group, October 1982. 24p.
ABSTRACT: This paper examines historical and physiological data concerning mine warfare. It then goes beyond those observations to consider how the psychological warhead in minefields can be exploited.
REPORT NUMBER: **CNA-PP-365**
ACCESSION NUMBER: ADA128244
http://www.cna.org/documents/5500036500.pdf

Hegy, Louis. **Project Shark**. Culver City, CA: Hughes Aircraft Co., March 1954.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0065929

______. **Project Shark**. Culver City, CA: Hughes Aircraft Co., June 1954.
ABSTRACT: None Available.]
ACCESSION NUMBER: AD0065902

Hegy, Louis. **Project Shark**. Culver City, CA: Hughes Aircraft Co., August 1954.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0065930

______. **Project Shark**. Culver City, CA: Hughes Aircraft Co., November 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0026127
http://handle.dtic.mil/100.2/AD026127

______. **Project Shark**. Culver City, CA: Hughes Aircraft, Co., July 1955. 8p
ABSTRACT: None Available.
ACCESSION NUMBER: AD0070235

Hibbert, Kirk R. **A Need for Systems Architecture Approach for Next Generation Mine Warfare Capability.** Monterey, CA: Naval Postgraduate School, 2006. 85p.
*ABSTRACT: When operating in a sea borne environment, sea mines can prevent U.S. Navy vessels from meeting operational objectives. Sea mines have the potential of damaging, or destroying ships at sea. The U.S. Navy conducts mine warfare (MIW) operations to meet this threat. Although effective against mining, our countermining operations are currently employing 1960*s technology in an attempt to keep pace with new Concepts of Operations (CONOPS). Today*s legacy MIW processes currently employed by the warfighter, although capable of countering the mining threat, are a reactive process that is slow to engage and employ assets that are cumbersome to operate. With the advent of new technologies, a transformation of MIW capability is on the horizon and has the potential of influencing how the U.S. Navy maintains maritime dominance in the open oceans and littoral environments. The influence that technologies bring to MIW includes multi-spectral sensors, laser imagery, compact modular systems, unmanned and semi-autonomous weapons, as well as new communications architecture and tactics. Although these technical innovations present a level of capability superior to the existing legacy systems, developmental barriers and the lack of an overarching*

*systems architecture will hinder or prevent these systems from being effectively integrated into tomorrow*s CONOPS.*
ACCESSION NUMBER: ADA457204
http://handle.dtic.mil/100.2/ADA457204
http://edocs.nps.edu/npspubs/scholarly/theses/06Sep%5FHibbert.pdf

Holden, Kevin T. **Mine Countermeasures: What the Operational Commander Must Know**. Newport, RI: Naval War College, Department of Operations, 8 February 1994. 35p.
ABSTRACT: A great deal has been written concerning the need for more and improved mine countermeasures equipment. What seems lacking is adequate focus at the operational level regarding how to effectively and efficiently employ existing systems in support of current and future operations. In many situations, to achieve a military objective, it is essential the operational commander know the existing or potential mine threat, understand current mine countermeasure capabilities, determine the available courses of action, and select the course of action that will provide the highest probability of success in support of an assigned mission. This paper is intended to emphasize the importance of mine countermeasures to the operational commander. It draws upon the lessons of history to show that mine warfare has had a significant impact on naval and joint operations. while the paper addresses some technical and tactical aspects of mine countermeasures, the primary focus is on the operational considerations and options available to the operational commander.
ACCESSION NUMBER: ADA279712
http://handle.dtic.mil/100.2/ADA279712

Holmes, W. C., et al. **German Acoustic Mine Unit**. Technical report. Naval Technical Mission in Europe. September 1945. 68p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953134

_______. **German Induction Mine Units**. Technical report. Naval Technical Mission in Europe. September 1945. 8p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953467
http://handle.dtic.mil/100.2/ADA953467

_______. **German Mine Clocks**, **Period Delay Mechanisms**, **Sterilizers and Associated Devices**. Technical Report. Naval Technical Mission in Europe. September 1945. 46p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953436
http://handle.dtic.mil/100.2/ADA953436

_______. **German 'Seismik' Mine Unit**. Technical report. Naval Technical Mission in Europe. September 1945. 6p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953469
http://handle.dtic.mil/100.2/ADA953469

_______. **German ‘Wellensonde’ (Wave Sounder) Mine Unit**. Technical report. Naval Technical Mission in Europe. September 1945. 6p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953470
http://handle.dtic.mil/100.2/ADA953470

_______. **Modifications of the German M 1 Unit**. Technical report. Naval Technical Mission in Europe. September 1945. 8p.
ABSTRACT: None Available.
ACCESSION NUMBER: ADA953468

Hurley, William J. **Naval Mining and Technology**. Alexandria, VA: Institute for Defense Analyses, April 1997. 9p.
ABSTRACT: In April 1997, a senior panel convened at Institute for Defense Analysis (IDA) to address the future of the U.S. naval mining program. This short paper was prepared as background reading for the panel. It briefly reviews some of the pros and cons of maintaining a traditional mining capability, lists areas of advancing technology that are relevant to this warfare area, and discusses the implications of these technologies for the traditional issues.
REPORT NUMBER: IDA-D-2058
ACCESSION NUMBER: ADA355035
http://handle.dtic.mil/100.2/ADA355035

Hurley, William J., et al. **General Approach to Investing in the New Modeling and Simulation Tools With A Case Study: Naval Mine Countermeasures Programs**. Alexandria, VA: Institute for Defense Analyses, July 1995. 218p.
ABSTRACT: Recent advances in computing, networking and visualization have led to dramatic improvements in modeling and simulation (MS) capabilities. The key issue for DoD is how to successfully convert these impressive technical developments into useful tools for addressing DoD's needs. This study proposes a general framework for deciding how to invest in the new MS tools. The framework begins with an articulation of a key need facing the decision maker. It then addresses the potential roles for MS in meeting that need, the implied characteristics of the MS tools, their costs, value added, risks, funding, and management. It then repeats this process for a range of needs facing the decision maker, and, by looking for common elements and setting priorities, seeks to integrate the results across all of the needs into a single MS plan. As a case study, this process is applied to the area of naval mine countermeasures (MCM). No detailed road map for MS investment is given, but the issues that arise are described along with some methods that may be used to resolve them. A strawman approach to MCM MS investments is presented. This is a 'fleet first' approach which focuses initially on training, tactical development and mission rehearsal with later applications to acquisition once acceptance of the MS tools, and confidence in them, have been established. The general framework described should be applicable to any area where the benefits and costs of the new MS tools are under consideration.
ACCESSION NUMBER: ADA305451
http://handle.dtic.mil/100.2/ADA305451

Jasper, Norman H. **Ship Signature Modifier**. Patent. Washington, DC: Department of the Navy, Filed 27 November 1968, patented 21 September 1993. 6p.
ABSTRACT: A unique system of disposition-controlled, water-filled, fabric bags is suspended from and towed beneath a ship to effect the modification of the inherent water pressure signature thereof and thus prevent detonation of a marine mine programmed to be exploded thereby.

REPORT NUMBER: PATENT: 5,245,928
http://www.uspto.gov/patft/

Kaminski, Paul G. **Affordable Naval Mine Warfare**. Washington, DC: Office of the Under Secretary of Defense (Acquisition and Technology), 11 June 1996. 9p.
ABSTRACT: This report contains information concerning naval mine warfare. The document addresses threats and future naval mine warfare issues.
ACCESSION NUMBER: ADA339429
http://handle.dtic.mil/100.2/ADA339429

Kaufman, Alfred I. and E. Zdankiewicz. **Gauging the Military Value of Naval Infrastructure**. Alexandria, VA: Institute for Defense Analyses, March 2001. 47p.
ABSTRACT: This paper proposes a methodology for relating investments in naval infrastructure programs to investment programs in naval structure and illustrates the utility of such a methodology in trading infrastructure for structure by applying the methodology to organic mine countermeasure and shallow water antisubmarine operations.
REPORT NUMBER: IDA-P-3605
ACCSSION NUMBER: ADA394149
http://handle.dtic.mil/100.2/ADA394149

Kaufman, Alfred I., et al. **The Future of U.S. Naval Mines**. Final report. Alexandria, VA: Institute for Defense Analyses, August 1997, 17p.
ABSTRACT: This White Paper reports on the deliberations of a panel of individuals who have at some previous time held highly responsible positions in the government of the United States: The Honorable Richard Cheney, Dr. Richard L. Garvin, The Honorable John 0. Marsh, Jr., The Honorable Robert C. McFarlane, Rear Admiral John M. Poindexter, USN (Ret), Professor David Rosenberg, General William Y. Smith, USAF (Ret.), Admiral Carlisle A.H. Trost, USN (Ret), The Honorable Paul Wolfowitz, The Honorable R. James Woolsey, and Admiral Ronald J. Zlatoper, USN (Ret). This senior panel sat to consider the question of whether the United States ought to develop and maintain a modern naval mining capability. At the end of the day, the panel concluded that the United States Navy should stay in the business of naval mining. The panel recommended that an R&D program, not to exceed $30M a year, be initiated to undertake the process of creating a flexible and affordable stockpile of naval mines.
REPORT NUMBER: IDA-P-3326
ACCESSION NUMBER: ADA332909
http://handle.dtic.mil/100.2/ADA332909

Keegan, John J. **Trajectory Planning for the Aries AUV**. Monterey, CA: Naval Postgraduate School, June 2002. 116p.
ABSTRACT: This thesis supports ongoing ONR research in the area of Autonomous Underwater Vehicles (AUVs) and Mine Warfare. It shows a simulation of a two- vehicle autonomous rendezvous using both along track and cross track position controllers. Conducting open water experiments with the ARIES AUV identified the added mass matrix and hydrodynamic coefficients of the longitudinal equation of motion. The results indicate that it will be possible to maneuver an AUV to a specific rendezvous point at a specified time. Two-vehicle rendezvous maneuvers are likely to be needed in multi-vehicle operations when data transfer between range-limited communications modems are used.
ACCESSION NUMBER: ADA405600
http://handle.dtic.mil/100.2/ADA405600
http://edocs.nps.edu/npspubs/scholarly/theses/02Jun%5FKeegan.pdf

Kehrer, W.S. **Aerial Survey of the Contaminated Ocean Surface at Operation Wigwam**, **With Dose Rate Contour Lines Through D+4 Days**. San Francisco, CA: Naval Radiological Defense Laboratory, February 1966. 54p.
ABSTRACT: Aerial survey was utilized to measure the radiation intensities above the contaminated pool at Operation Wigwam. These field data were used to provide a detailed analysis of the radiation field at 3 ft. above the surface through D + 4 days, and to determine the hazard to personnel on board ships traversing the area.
REPORT NUMBER: USNRDL-TR-981
ACCESSION NUMBER: AD0481165

Kostygov, B. D. **Mine-Torpedo Weapons During the Years of Soviet Power.** Washington, DC: Department of the Navy, October 1967. 9p. Translation of **Morskoi Sbornik** (USSR) no. 9, p. 34-38, 1967.
ABSTRACT: A brief history is given of the development and employment of naval mines and torpedoes in Russia. Particular attention is given to the developmental work done between World Wars I and II.
ACCESSION NUMBER: AD664228
http://handle.dtic.mil/100.2/AD664228

Krumm, Theodore G. **Mine Delivery Model: A Computer Simulation**. Monterey, CA: Naval Postgraduate School, May 1966. 420p.
ABSTRACT: The Mine Delivery Model is a Monte Carlo computer simulation of the delivery of mines in detail by ships, submarines, and/or aircraft. Inputs are of such a nature as to permit the simulated execution of any specific mining plan and the outputs provide sufficient information for subsequent evaluation of the plan by a threat assessment model. The model as programmed for the CDC 1604 Computer consists of five programs. The first two programs convert input data, the third and main program is the mine delivery simulation, the fourth program provides a detailed printout of both inputs and game results, i.e., the calculated parameters for each mine layed accompanied by selected statistics, and the fifth program provides statistics and graphs on the distributions of the mine positions.
ACCESSION NUMBER: AD0486069

Lessons of the Falklands. Summary Report. Washington, DC: Department of the Navy, February 1983. 78p.
ABSTRACT: Contents: Air Operations; Antiair Warfare/Antiship Missile Defense; Antisubmarine Warfare; Antisurface Warfare; Amphibious Warfare; Command, Control, and Communications; Electronic Warfare; Intelligence; Environmental Conditions; Logistics/Sustainability; Mine Warfare; Personnel; Press Coverage; Readiness and Mobilization; Ship Survivability; Special Forces Operations; Submarine Operations; Surface Ship Operations.
ACCESSION NUMBER: ADA133333
http://handle.dtic.mil/100.2/ADA133333

Lindgren, Edwin D. **Impact of Mine Warfare Upon U.S. Naval Operations During the Civil War**. Master's thesis. Fort Leavenworth, KS: Army Command and General Staff College, 1994. 119p.
ABSTRACT: This study investigates the impact of Confederate naval mine warfare against the operations of the U.S. Navy during the Civil War. Mine warfare was a cost effective method for the Confederacy to defend its long coastline and inland waterways. A wide variety of fixed, moored, and drifting mines were deployed and used with effect at locations along the Atlantic

coast, the Gulf coast, and along rivers, including those in the Mississippi basin. Despite loss and damage to thirty-five Union naval vessels, mine use had virtually no strategic impact upon the course of the war. At the operational level, effects were apparent. Federal naval operations at Charleston and on the Roanoke River were frustrated, in large part because of the mine threat. The impact of mines was great at the tactical level. These cost effective weapons caused delays in Union operations, resulted in involved countermine operations, and caused fear and apprehension in crews. The lessons from the mine warfare experience of the Civil War are still applicable in today's warfare environment. Naval mines are a preferred weapon of minor naval powers and the U.S. Navy will be required to deal with this threat when operating in the World's coastal regions.

ACCESSION NUMBER: ADA284553
http://handle.dtic.mil/100.2/ADA284553

Lluy, Paul A. **Mine Warfare: An Old Threat Presents New Challenges for NATO's Post-Cold War Navies**. Master's thesis. Monterey, CA: Naval Postgraduate School, December 1995. 211p.

ABSTRACT: This thesis analyzes the possible implications to global maritime interests posed by the growing international proliferation of advanced sea mines, and examines the role of NATO's mine countermeasures (MCM) forces in countering this threat in the post-Cold War security environment. It is argued that, given the Iraqi mining success during the Gulf War, the current global proliferation of sophisticated sea mines, and deficiencies in the international laws which govern their use, mine warfare will present a growing threat to vulnerable Western nations into the next century. Consequently, NATO's mine countermeasure forces will have a prominent role in future Alliance or UN-mandated out-of-area naval contingencies, ranging from counter-terrorism operations to major regional conflicts, and will be called upon to provide a credible MCM capability to protect Alliance and coalition naval forces, secure vital sea lines of communication (SLOCs), and ensure unimpeded maritime freedom of the seas prescribed under international law. NATO's capability to meet these challenges will depend largely on its ability to reorient its focus toward the requirements necessary to train and maintain a first-rate MCM rapid deployment force. As a leader within NATO, the United States Navy must assume the lead in forging multinational transatlantic MCM forces capable of dealing with any global mining contingency.

ACCESSION NUMBER: ADA305846
http://handle.dtic.mil/100.2/ADA305846

Lu, Han-Chung. **Using Expert Systems in Mine Warfare**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1991. 90p.

ABSTRACT: Historically, sea mines warfare have played an important role in warfare, which a naval officer cannot afford to neglect. During the recent mine campaign in the Middle East involving Iran an Iraq, commanders delayed decisions on whether or not to deploy mine countermeasure (MCM) forces. As a result, damage occurred to ships in a minefield that could have been prevented by the speedy application of MCM. Before the operational mission commenced, there are several uncertain questions in the mind of the commander: Do the mine-fields exist. Which country laid the mines. What type of delivery platform laid the mines. Where are the mines. What kind of mines are they. Do we need to deploy the MCM forces. Previously, these kinds of fuzzy questions were very difficult to answer by a tactical principle. In this thesis, the probabilistic inference network in the expert system environment is used to answer the above questions. The probabilistic inference network method is supported by the certainty factors. Calculations involving quantitative probabilities for answers to the above questions could enable the MCM experts to offer suggestions to the commander for reducing the ship's vulnerability at sea during wartime.

ACCESSION NUMBER: ADA247758
http://handle.dtic.mil/100.2/ADA247758

Marolda, Edward J. and G. W. Pryce. **A Select Bibliography of the United States Navy and the Southeast Asian Conflict 1950 - 1975.** Washington, DC: Naval Historical Center, June 1982. 54p.
ABSTRACT: General Titles; Strategy, Tactics, and Policy; Air Operations; Riverine Operations; Coastal Patrol; Amphibious Warfare; Naval Gunfire Support; Special Operations; Mine Warfare; Advisors and Military Assistance; Civic Action; Maritime Evacuations; Military Construction; Logistic Support; Medical Support; Ships, Weapons, and Material; Prisoners of War; Tonkin Gulf Incident; Miscellaneous.
ACCESSION NUMBER: ADA122955
http://handle.dtic.mil/100.2/ADA122955

McKeehan, Louis W. **Operation Mud**. New Haven, CT: Yale University, Laboratory of Marine Physics, October 1952.
ABSTRACT: None Available.
ACCESSION NUMBER: AD024996

McMahon, James Patrick. **Steady and Oscillatory Flow Forces on a Mark 6 Moored Mine**. Master's thesis. Monterey, CA: Naval Postgraduate School, 1956. 108p.
ABSTRACT: A theoretical investigation is made of the forces acting upon a moored mine due to uniform and oscillatory fluid flow. The general problem is discussed analytically and approximate methods are presented to ascertain the forces to be expected.
ACCESSION NUMBER: AD0826369

McMaster, Robert L., et al. **Physical Characteristics of Additional Mine Behavior Test Areas**. Interim Report. no. 3. Rhode Island University, Kingston, Narragansett Marine Laboratory, June 1955.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0067464

_______. **Mine Behavior Studies** (1955). Rhode Island University, Kingston, Narragansett Marine Laboratory, December 1955.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0082793

Mines, **Antivehicular.** Final report on test operations procedure. Aberdeen Proving Ground, MD: Army Test and Evaluation Command, February 1972. 6p. Supersedes **AD0724077** and **AD0725536**.
ABSTRACT: The report provides a method for evaluation of antivehicular mine operational and functional characteristics. It identifies supporting tests, facilities, and equipment required. Provides procedures for functional suitability tests. It is applicable to land and underwater mines.
REPORT NUMBER: AMCR-310-6
ACCESSION NUMBER: AD0741099

Morgan, K.R. and M. Fennewald. **Unmanned Testing of Fullerton Sherwood SIVA VSW Underwater Breathing Apparatus (UBA) for Very Shallow Water (VSW) Mine Countermeasure (MCM) Mission**. Panama City, FL: Navy Experimental Diving Unit, October 1999. 20p.
ABSTRACT: In response to the continuing challenge of conducting MCM in depths between 10 to 40 fsw, the CNO has authorized the Near Term Mine Warfare Campaign Plan. This plan includes the establishment of the VSW MCM Detachment as a primary supporting unit. Presently, no specific diving apparatus on the ANU list meets the demands set forth by CNO to conduct VSW MCM operations. NEDU has been tasked to test and evaluate the Fullerton Sherwood SIVA VSW UBA to determine if it meets the stringent requirements for operating in this mission area. NAVSEA Diving Safety Certification requirements must be met to achieve the designation of 'Authorized for Navy Use' set forth by NAVSEA 00C prior to fielding any UBA in the U.S. Navy. This report deals with the conduct of unmanned diving tests and procedures to verify functional characteristics in accordance with manufacturer's specifications and the VSW MCM UBA Performance Specification.
ACCESSION NUMBER: ADA371173
http://handle.dtic.mil/100.2/ADA371173

Morien, Steven B. **The Operational Effects of Mine Warfare**. Newport, RI: Naval War College, 5 February 1999. 28p.
ABSTRACT: This paper demonstrates that naval mines are a threat to the operational commander and that there are actions he can take to reduce the operational effects of mine warfare. The first section demonstrates that mine warfare is a pertinent problem for the operational commander by examining three principle relationships. It examines the history of mine warfare from an operational perspective, warfare in the context of operational art and mine warfare in the context of the U.S. Navy and U.S. Marine Corps service visions. The second part of the paper explores the Mine Countermeasures (MCM) concept of operations, the difficulties countering the mine problem with recommendations to minimize the operational effects and lastly, the future of mine warfare in the context of "Joint Vision 2010" and beyond. This paper shows that the operational commander can minimize the operational effects of mine warfare by preventing mining, maintaining surveillance, minimizing maneuver space requirements, requesting MCM forces early in crisis, using creative schemes of maneuver and exploiting the miner's resource and environmental limitations.
ACCESSION NUMBER: ADA363227
http://handle.dtic.mil/100.2/ADA363227

Mortiz, C. E. **Antifouling Grease on Mine Cable**, **Test Report and Preliminary Recommendation**. White Oak, MD: Naval Ordnance Laboratory, February 1944. 3p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0071105

_______. **Recommendations Regarding Anticorrosive and Antifouling Measures for Mines**. White Oak, MD: Naval Ordnance Laboratory, August 1943. 19p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0071441

Mounce, Whitman D. and Ralph W. Mann. **Mine Firing Control System**. Patent. Washington, DC: Department of the Navy, January 1980. 14p.
ABSTRACT: In a mine firing control system of the character disclosed, the combination of a mine firing control circuit including a plurality of electron discharge devices each of which is adapted to be rendered conducting when the bias voltage thereon is elevated to a predetermined value, circuit means including a first normally conducting electron discharge device for applying said bias voltage to said plurality of electron discharge devices, circuit means including a second normally non-conducting electron discharge device adapted to render said first electron discharge device non-conducting as said second electron discharge device is rendered conducting, means controlled by said mine firing control circuit for rendering said second electron discharge device conducting as the control circuit operates, and means for operating the control circuit.
REPORT NUMBER: PATENT: 4,185,552
http://www.uspto.gov/patft/

Mulhearn, P. J., et al. **Sediment Properties Off Cairns.** (A Report on Data obtained in August 1996)**.** Melbourne, Australia: Defence Science and Technology Organization, June 1998. 62p.
ABSTRACT: This report describes the properties of sediments off Cairns, North Queensland, obtained from samples gathered during trials with A.M.s Brolga and Bermagui in August 1996. These data were obtained in a survey of seabed properties to determine suitable sites and transects for TTCP trials of environmental reconnaissance techniques, which occurred in April/May 1997. The data are relevant to mine burial, acoustic propagation and high frequency reverberation, all important factors in mine warfare. The results form a worthwhile addition to the Mine Warfare Systems Centre and Australian Oceanographic Data Centre data bases, especially as the Cairns area appears to be typical of much of North Queensland's eastern coast and the data herein include much information on sediment shear and bearing strengths, parameters which are critical to impact burial but which are rarely measured.
REPORT NUMBER: DSTO-TN-0154
ACCESSION NUMBER: ADA355873
http://handle.dtic.mil/100.2/ADA355873

NAVY-21 UPDATE: Implications of Advancing Technology for Naval Operations in the Twenty-First Century. Washington, DC: National Research Council, 1993. 70p.
ABSTRACT: In the summer of 1988, the National Research Council issued the Naval Studies Board's report Implications of Advancing Technology for Naval Operations in the Twenty-First Century, known as Navy 21 (National Academy Press, Washington, D.C.). The study had been carried out over the previous 18 months, at the U.S. Navy's request. In the terms of reference for that study, the Chief of Naval Operations (CNO) asked how future technological trends might change Navy force structure, what the impact of those changes on U.S. maritime strategy might be, and how the Soviet Union might respond. The study involved 188 civilian experts and 22 Navy and Marine Corps liaison officers. It was informally agreed when the study was completed that it represented a broad and solid base from which to continue to examine the Navy's future problems, and that it would be useful to reexamine the position of the Navy and the country every 5 to 10 years, to see what trends had been reinforced, what trends had changed, and how the differences would affect the Navy from then on. The purpose of this report is to revisit the 1988 Navy-21 forecast of Navy trends and technological opportunities in light of world events in the 5-year period from 1988 to 1993. A few major themes emerged from this update of the 1988 Navy-21 report, as indicated: (1) Orienting to a New Environment; (2) The Information War Is Crucial: Intelligence, Combat Information Network, Battle Management; (3) Air and Surface Forces: A New Balance-Precision Strike, Focused Defense; (4) Amphibious Forces: Enhanced Force Projection Ashore; Countermine Critical; (5) Undersea Forces: Other Than Strategic

Forces, Shore Oriented; and (6) New Approaches to Managing Technology and People Issues for Urgent Navy Attention.
ACCESSION NUMBER: ADA306545
http://handle.dtic.mil/100.2/ADA306545

Newman, J. N., P. Plaia, and E. E. Zarnick. **Pitching Motions of a Moored Submerged Mine in Waves**. Final report. Washington, DC: David Taylor Model Basin, Hydromechanics Laboratory, March 1966. 30p.
ABSTRACT: This report describes a theoretical and experimental investigation of the pitching motions of a moored, submerged mine. The theoretical predictions are based upon linearized-wave theory as well as the assumptions that the body is slender and axisymmetric and is ballasted to be at equilibrium in the horizontal plane. The mooring cable is assumed to be massless and inelastic; the fluid is assumed to be inviscid. The theory results in an equation of undamped motion. Parallel experimental results were obtained on a 2-foot long model in wavelengths ranging from 15 to 55 feet, and these results confirm the theoretical predictions except in the vicinity of resonance, where viscous damping is important. Full-scale predictions are made for the root-mean-square pitching motions in Sea States 4 through 7 for two proposed mine configurations at various depths of submergence. The predicted values are from 1 to 9 degrees in Sea State 4, depending on depth and mine configuration, increasing to greater than 25 degrees in Sea State 7.
REPORT NUMBER: **DTMB-2151**
ACCESSION NUMBER: AD632077
http://handle.dtic.mil/100.2/AD632077

Niemann, K. P. **Mine Warfare Forces**. Washington, DC: Naval Intelligence Support Center,. Translation Division: 25 April 1983. 10p. [Trans. of **Soldat und Technik**, D 6323 E, n.p., v. 2, p. 62-67, February 1983.]
ABSTRACT: No abstract available.
ACCESSION NUMBER: ADA128971

Page, Richard L. **Impact of Naval Mining on Operational Maneuver and Planning**. Newport, RI: Naval War College, 3 June 1996. 23p.
ABSTRACT: Despite the fact that U.S. Armed Forces have repeatedly seen and felt the impact of naval mining during this century, naval mine countermeasures capabilities have yet to be fully evaluated and accurately addressed in today's operational planning. Naval mine warfare, one of the least expensive and easiest to deploy methods of warfare, has the ability to prevent or delay opponents from achieving the critical operational functions of maneuver and mobility. This being the case, it is imperative that the operational commander recognize and adequately plan for a naval mining threat within a theater of operations. Operational plans for maneuver within the maritime environment must include all of the complex mine warfare variables in development of realistic timelines for maneuver and operational progression. An accurate mine clearance timeline is critical to the commander's assessment of an operational plan's feasibility. If the primary sea line of communication is unavailable within operational deadlines, alternative plans must be developed. Alternative options available to the operational commander are secondary sea lines of communication or a combination of sea lines of communication and extensive air/land lines of communication. These alternatives must be fully addressed and played in exercises which test operational plans and serve to familiarize all concerned with the dramatic impact of naval mining on operational maneuver and the mobility of forces.
ACCESSION NUMBER: ADA312219
http://handle.dtic.mil/100.2/ADA312219

Patterson, Andrew Jr. **Experimental Study of MK 6 Acoustic System for MK 51 Controlled Mines**. New Haven CT: Yale University, Laboratory of Marine Physics, April 1952.
ABSTRACT: None Available.
ACCESSION NUMBER: AD024999

Patterson, Andrew, Jr. and Robert A. Winters. **Historical Bibliography of Sea Mine Warfare**. Washington, DC: National Academy of Science, National Research Council, Mine Advisory Committee, January 1976. 146p.
ABSTRACT: One of the several objectives of the PROJECT NIMROD effort was to correct a number of misconceptions regarding the effectiveness of the mine as a modern naval weapon: misconceptions which consistently rendered more difficult the support of an aggressive research and development program. The results of this effort were included in the final report of PROJECT NIMROD, and subsequently issued as a separate report entitled 'A Brief History of Mine Warfare.' Research on the 'History' provided an unique opportunity to assemble most of the historical literature on mine warfare. Having gone to considerable effort to identify and gain access to well over two thousand documents, continuing to the present time, the authors believe the effort should be preserved in the form of a bibliography for use by future researchers. This document is offered for that purpose.
ACCESSION NUMBER: ADA058556
http://handle.dtic.mil/100.2/ADA058556

Perraut, Richard E., Jr. **Gulf War Lessons Learned by Iraq (A.K.A. How to Fight the United States and Win).** Final report. Newport, RI: Naval War College, 17 June 1994. 37p.
ABSTRACT: The invasion of Kuwait was undertaken by Saddam Hussein to solve his severe economic problems, to fix a historical claim, to secure access to the Persian Gulf, and to increase his personal power and status within the Middle East. Iraq's campaign was built on some flawed assumptions and unraveled in execution. In a future campaign to invade Kuwait, Iraq could apply what it learned from the Gulf War. There are two main approaches: what Iraq could do to keep the United States out of the Gulf and how to fight deployed U.S. forces. Keeping U.S. forces out of Saudi Arabia would greatly hamper U.S. efforts to liberate Kuwait. If U.S. forces are deployed to the region, Iraq has three options. First, Iraq could fight the United States nose-to-nose and seek a negotiated settlement before the United States overwhelms the Iraqi forces. Secondly, Iraq could attempt to bloody the U.S. nose with attacks to inflict massive casualties in order to undermine the U.S. and Saudi Arabia's will to continue military actions against Iraq. And thirdly, Iraq could immediately seek a negotiated settlement hoping to keep at least part of Kuwait. Based on these approaches and options, USCENTCOM faces many serious planning challenges for the next Gulf War in terms of responding, deploying, and fighting. Gulf War, Desert Storm, WMD, Sea mines, Coalition, Saudi Arabia, Kuwait, Iraq, Saddam, USCENTCOM.
ACCESSION NUMBER: ADA283409
http://handle.dtic.mil/100.2/ADA283409

Pritchard, Lane L. **Distributed Computing Environment for Mine Warfare Command**. Monterey, CA: Master's thesis. Naval Postgraduate School, June 1993. 108p.
ABSTRACT: The Mine Warfare Command in Charleston, South Carolina has been converting its information systems architecture from a centralized mainframe based system to a decentralized network of personal computers over the past several years. This thesis analyzes the progress of the evolution as of May of 1992. The building blocks of a distributed architecture are discussed in relation to the choices the Mine Warfare Command has made to date. Areas that

need further attention and development are discussed based on the research findings. Finally, recommendation for future planning, procurement and improvements to the system are made. Lessons learned by this command during the conversion to a networked system are described.
ACCESSION NUMBER: ADA268799
http://handle.dtic.mil/100.2/ADA268799

Proceedings of the Ship Control Systems Symposium (7th) Held in Bath, England on 24-27 September 1981. Volume 1. Ministry of Defence, Bath (England): 27 September 1984. 115p. [See also Volume 2, **ADA211134**.]
ABSTRACT: Contents: Digital progress in the Royal Navy; US Navy control systems overview; Machinery control initiatives -- A Canadian perspective; Ship automation -- A Dutch view on practice and progress; Digital control and surveillance system for the M-Class frigate of the Royal Netherlands Navy; Propulsion control in the Swedish M80 Class Mine Countermeasures Ships; Practical experience in the application of microprocessors to machinery control and surveillance; Multivariable adaptive control of ships motions; A classical approach to a microprocessor based PID Autopilot design; Model tests and full-scale trials with a rudder-roll stabilisation system.
ACCESSION NUMBER: ADA211133
http://handle.dtic.mil/100.2/ADA211133

Research and Exploratory-Development Event Descriptions. Appendix I. A Study of the Research and Exploratory-Development Origins of the Naval Mines Mark 56 and 57. Report on Project Hindsight - Task 1. White Oak, MD: Naval Ordnance Laboratory, June 1966. 249p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0835045
http://handle.dtic.mil/100.2/AD835045

Rios, John J. **Naval Mines in the 21st Century: Can NATO Navies Meet the Challenge?** Monterey, CA: Naval Postgraduate School, 2005. 61p.
ABSTRACT: With the end of the Cold War, NATO countries have embarked on transformation initiatives within their militaries to address the new security realities of the 21st century. One of the realities that has not changed is the threat posed to modern navies by sea mines. Global proliferation of sea mines, both older variants and advanced designs, has continued to grow and presents a unique challenge to maritime security for NATO. As NATO forces engage in more expeditionary operations, they must be prepared to counter the danger posed by mines from state and non-state actors. This includes ensuring that vital sea lines of communication (SLOCS), strategic chokepoints throughout the world, commercial ports and naval bases remain open and uncontested. In order to meet the challenge of the 21st century mine threat, NATO must continue to develop balanced MCM capabilities that satisfy expeditionary requirements (such as OMCM for in-stride operations) while maintaining effective dedicated forces to conduct sustained MCM operations against more traditional mining operations.
ACCESSION NUMBER: ADA435603
http://edocs.nps.edu/npspubs/scholarly/theses/05Jun%5FRios.pdf
http://handle.dtic.mil/100.2/ADA435603

Russell, Bruce F. **Operational Theater Mine Countermeasures Plan: More Than a Navy Problem**. Monograph. Fort Leavenworth, KS: Army Command and General Staff College, 14 May 1995. 54p.
ABSTRACT: This monograph finds that theater commanders, with vital maritime choke points/canals in their theater, should have their J-5 planners develop and integrate a

comprehensive counter mine plan into the theater's campaign plans. In the past, regional mine countermeasure's plans have been viewed as a Navy responsibility. However, today's theater commander may face short regional conflict warning times which require the conduct of mine countermeasures (MCM) operations before Naval MCM planners and their forces (ships and aircraft) can arrive in theater. Using joint theater forces (Army, Air Force, Special Operations Forces, Navy, and Space assets), the theater commander can conduct MCM operations to prevent mines from going in the water or to detect and record locations of enemy mine laying operations, reducing greatly the time required for counter mine operations by Naval MCM ships and aircraft upon their in-theater arrival. The coordination and allocation of Joint theater forces to conduct MCM operations requires a theater commander to plan and prepare for mining threats long before the first enemy sea mine enters the water. This monograph uses the Secretary of Defense's October 1993 Report on the Bottom-Up Review as a reference, to identify real world MCM missions from a scenario that involves two nearly simultaneous conflicts in the Korean and Persian Gulf regions. To execute counter mine missions in these theaters, the J-5 planning staffs must develop MCM plans for the theater commander. This monograph takes the J-3 planner through the required building blocks to develop an effective theater MCM plan. The monograph describes the North Korean and Iraqi mining threats, past and present, to include mine types, mine delivery platforms, and possible battlespace areas that could be effectively mined. The strengths and weaknesses of U.S. MCM forces, ships and aircraft.

ACCESSION NUMBER: ADA301152

http://handle.dtic.mil/100.2/ADA301152

Ryan, P. J. and C. J. Akenfelds. **Effect of Ship Motion on Ship Magnetic Signature.** Ascot Vale (Australia): Materials Research Laboratories, May 1988. 33p.

ABSTRACT: The effects of roll, pitch and yaw motions on a ship's magnetic signature are investigated. These three modes of rotary motion, each simple harmonic, are treated as uncoupled and a dipole model representation is used to describe the ship's magnetization. Signatures are computed for a model ship assumed, for simplicity, to be bearing due magnetic North and compared with the steady-state signatures (for no rotary motion). Oscillatory magnetic field components result from these ship motions which decrease in significance, compared to the steady-state fields, as the observation point is moved further away from the ship's passage. These field deviations decrease more rapidly with a beam displacement than with depth. Variation with ship speed is more complicated and depends critically on the values assigned for the amplitudes, frequencies, and relative phases of the three modes of motion. In high sea states the magnetic signatures can vary considerably from those in calm seas with implications for magnetic-influence mine actuation.

ACCESSION NUMBER: ADA200045

http://handle.dtic.mil/100.2/ADA200045

Savitz, Scott. **Psychology and the Mined: Overcoming Psychological Barriers to the Use of Statistics in Naval Mine Warfare.** Alexandria, VA: Center for Naval Analyses, 2006. 40p.

ABSTRACT: Mine warfare (MIW) almost always entails uncertainty and imprecise assessments regarding risk. Statistics can be combined with intelligence estimates to help a commander asses the number of residual mines after a clearance operation has been completed. Despite the potential value of statistical analyses in mine warfare (MIW), both experimental psychology and historical examples demonstrate impediments to their use. The purpose of this paper is to enumerate both means by which statistical analyses can inform and complement commanders' judgement, and to illuminate some of the psychological factors that can prevent such analyses from being used effectively. By increasing awareness of human biases in judgement, and offering tools for statistical assessment as well as active debiasing, the paper aims to help commanders make better decisions in a mined environment.

http://www.cna.org/documents/D0013693.A2.pdf

Scala, Peter A. **U. S. Logistics Vulnerability: Major Regional Conflict With Iran**. Newport, RI: Naval War College, Department of Operations, 16 May 1994. 45p.

ABSTRACT: The United States has chosen to emphasize a power projection role for its military. This capability proved itself during Operation Desert Storm. However, Desert Storm also pointed out a significant weakness. To stop the U.S. military, an enemy need only interrupt the logistics chain. How well does the U.S. guard its Logistics ability? This paper addresses the possibility that a dedicated, marginally capable opponent could do significant damage to the U.S. Logistics system. This in turn could cause the U.S. to abandon or change national priorities.

ACCESSION NUMBER: ADA283377

http://handle.dtic.mil/100.2/ADA283377

Schnell, David A. **Stormy Waters: Technology**, **Sea Control and Regional Warfare.** Master's thesis. Monterey, CA: Naval Postgraduate School, June 1994. 165p.

ABSTRACT: An important aspect of the current strategic calculus is the diffusion of technology and proliferation of advanced weaponry, particularly naval weapon systems. This is of particular concern for the United States' Navy, historically the first on-scene and the likely target of any initial challenge to our presence. The Navy's new war-fighting doctrine, '...From the Sea' focuses the Navy on these challenges. However, it has not been complimented by the necessary recapitalization and procurement to make it truly operational. To bridge the gap between the doctrinal concepts of '...From the Sea' and current capabilities, the Navy must improve its ability to exercise sea control and dominate the littoral battlespace. This will require tough procurement choices and significant investments in mine warfare, advanced military aircraft and state-of-the-art C4I systems. It may also be necessary for the Navy to postpone certain improvements or abandon certain missions in order to refocus and selectively modernize elements of the fleet.

ACCESSION NUMBER: ADA283945

http://handle.dtic.mil/100.2/ADA283945

Stacy, Ernest B. **How Vulnerable are U.S. Critical Seaports to a Waterborne Mine Threat?** Newport, RI: Naval War College, Joint Military Operations Department, 2007. 25p.

ABSTRACT: The events of 11 September 2001 illustrate al Qaeda's high aspirations and desire to achieve maximum effect. Halting most or all shipping traffic to and from the United States, if only for a short time, would achieve such an effect. Terrorists may have drawn lessons from recent history, such as the 1990-1991 Gulf War and the 1980s Tanker War, with regard to naval mines. Mines are a simple, inexpensive, asymmetric threat that could be used to cause enormous economic damage to the United States. The probability of terrorists resorting to waterborne mining is almost impossible to determine. However, one can determine and implement measures aimed at reducing the United States' vulnerability. Examination of the possible effects, should deterrence fail, would also allow one to determine and implement a reasonable, well-prepared course of action to mitigate those effects.

ACCESSION NUMBER: ADA463869

http://handle.dtic.mil/100.2/ADA463869

Strain, Patrick M. **Amphibious Operations in the 21st Century: A Viable Forced-Entry Capability for the Operational Commander**. Fort Leavenworth, KS: Army Command and General Staff College, School of Advanced Military Studies, 14 May 1993. 67p.
ABSTRACT: Since the demise of the former Soviet Union, the world has witnessed greater international turmoil, aggression, and conflict. The possibility of a global conflict is minimal, but the opportunities for United States involvement in regional conflicts has increased in order to protect its vital interests. The current reductions in armed forces and forward deployment of units require the maintenance of a strong power projection and forced-entry capability. The two form of force-entry operations available to the operational commander are amphibious and airborne operations. The requirement to conduct amphibious forced-entry operations remains valid. The United States is a maritime nation and the majority of its interests lie close to the sea. However, the reduction in amphibious shipping, naval surface fire support, and mine-countermine capabilities, and the proliferation of advanced technology and weapons to potential third world foes, calls to question the ability of the United States to conduct traditional amphibious forced-entry operations. To remain viable in a much more lethal environment, amphibious operations must be conducted from a maneuver warfare perspective.
ACCESSION NUMBER: ADA274020
http://handle.dtic.mil/100.2/ADA274020

Stresau, R. H. and L. D. Hampton, L. E. Starr. **Boostering Requirements of Mines**. White Oak, MD: Naval Ordnance Laboratory, August 1956.
ABSTRACT: None available.
REPORT NUMBER: NAVORD-4277
ACCESSION NUMBER: AD0114068

Su, Ming-Yang, et al. **Developing a Joint Army/Navy Coastal Wave Prediction Program**. Stennis Space Center, MS: Naval Research Laboratory, 1996. 103p.
ABSTRACT: This planning report presents a technical summary and recommendations for jointly developing improved coastal wave prediction capabilities for the Army and Navy, and was prepared by the Army/ Navy Wave Prediction Group. Wave related physical processes are crucial for both Army and Navy operations, such as mine, amphibious, and logistics over the shore. Current coastal wave prediction capabilities are inadequate to meet several critical nearshore operational requirements. Nearshore physical environments are intrinsically more complicated than deep water due to strong interactions of waves with currents and irregular bathymetry. Important dynamic processes include wave shoaling, refraction, diffraction, and energy dissipation through wave breaking and bottom friction. Attention must be given to wave-driven nearshore processes, which in turn influence wave conditions. The fine resolution (both spatial and temporal) coastal wind forecasting plays an equally central role in this endeavor. Coupled with the increased complications of the coastal regions is the stringent requirement that many DoD coastal littoral warfare requires a higher level of accuracy than deep-water counterparts. This report presents a technical strategy with a vertically integrated approach for improving DoD wave prediction capabilities to advance current state-of-the- art. The strategy encompasses theoretical and experimental studies, comprehensive new field measurements, numerical modeling, and operational validation/evaluation/modification. Substantial common interests currently exist between the Army and Navy, thus a new R&D program jointly funded and executed is deemed to be timely and cost effective. The final deliverable of this joint program will be an improved integrated coastal wave prediction system for Army and Navy operational needs.
REPORT NUMBER: NRL/MR/7330--95-7686; NIPS-96-83400
ACCESSION NUMBER: ADA310243
http://handle.dtic.mil/100.2/ADA310243

Technology for the United States Navy and Marine Corps, **2000-2035. Volume 7: Undersea Warfare**. Washington, DC: National Research Council, Naval Studies Board. 1997. 124p.
ABSTRACT: This report is part of the nine-volume series entitled Technology for the United States Navy and Marine Corps, 2000-2035: Becoming a 21st-Century Force. The series is the product of an 18-month study requested by the Chief of Naval Operations, who, in a memorandum on November 28, 1995, asked the National Research Council to initiate through its Naval Studies Board a thorough examination of the impact of advancing technology on the form and capability of the naval forces to the year 2035. To carry out this study, eight technical panels were organized under the committee on Technology for Future Naval Forces to examine all of the specific technical areas called out in the terms of reference.
ACCESSION NUMBER: ADA360010
http://handle.dtic.mil/100.2/ADA360010
http://www.nap.edu/html/tech_21st/uwindex.htm

Thomas, Marc J. **Missing from the Toolbox: Preemptive Strike**. Final report. Newport, RI: Naval War College, 16 May 1995. 21p.
ABSTRACT: The national security strategy of the United States requires the military to prosecute two nearly simultaneous major regional conflicts. This is similar to the Israeli asymetric strategy of fighting one enemy white holding another. Once the first is defeated, Israeli attention focuses on defeating the second enemy. To make the strategy work, the Israelis pre-emptively strike their enemies to gain the initiative. American national strategy does not include a provision for preemptive action. Past American wars, including the Persian Gulf War, relied on a significant build-up of regional combat power before taking offensive action. An enemy might conclude that the best way to fight the United States is to isolate the region from the introduction of U.S. forces. A combination of sea mines and an anti-air lift plan could keep U.S. forces from a theater. Because sea mining is likely to be part of an initial enemy action, preempting sea mining operations is as important as gaining air superiority. Once the sea mines are planted, will take significant time to conduct mine counter-measures operations. An enemy with a clearly defined objective and good diplomatic initiative could use the time that the U.S. was isolated from the theater to gain a peace on its terms.
ACCESSION NUMBER: ADA297956
http://handle.dtic.mil/100.2/ADA297956

Trinque, Derek A. **Sea Basing: Persistent Power Projection in the Face of the Naval Mine Threat**. Newport, RI: Naval War College: Joint Military Operations Department, 2004. 24p.
ABSTRACT: Sea Basing is a viable concept for the projection of joint forces, even in the presence of a naval mine threat. Operation IRAQI FREEDOM shows that the United States will not always be able to rely on host nation support and basing. Sea Basing offers an alternative to basing forces ashore in host nations. A Sea Base is inherently joint, and less vulnerable to attack than land-based forces. Despite the relative security of Sea Basing, area access denial weapons can threaten the Sea Base. Primary among these threats are naval mines. The widespread proliferation and simplicity of mines make them an ideal weapon for a weak coastal state. The U.S. Navy has a checkered past with respect to mine warfare, but ongoing innovations have potential to improve mine countermeasures throughout the fleet. To counter the mine threat, commanders can attempt to prevent mines from being laid, avoid laid mines, clear the mines, or choose to operate in mined waters after assessing the risk. Prevention of minelaying requires permissive ROE, and persistent ISR. Avoiding mines requires persistent ISR. Mine clearance requires a significant amount of time. Naval planners and JFCs should continue to pursue the

development of Sea Basing capabilities. By ensuring future expeditionary forces are compatible with Sea Basing, and improving the organic MCM capability of naval forces, commanders and force planners can greatly improve the flexibility of joint power projection.

ACCESSION NUMBER: ADA422745

http://handle.dtic.mil/100.2/ADA422745

U.S. General Accounting Office. **Issues Identified in 21 Recently Published Major Weapon System Reports.** Washington, DC: The Office, Procurement and Systems Division, June 1980. 92p.

ABSTRACT: This report summarizes 21 major weapon system reports we issued during January and February 1980. The purpose is to focus attention on the principal issues found to be common among several weapon programs. The report also serves as a quick reference to all our major acquisition work during the past 12 months. The majority of issues affecting the weapon systems' mission effectiveness are concerned with operational or performance limitations, survivability or vulnerability, availability, requirements, and reliability.

REPORT NUMBER: GAO/PSAD-80-43

http://archive.gao.gov/f0202/112558.pdf

U.S. General Accounting Office. **Mine Warfare: Ingleside**, **Texas**, **May Not Be the Best Location for Consolidation.** Washington, DC: General Accounting Office, National Security and International Affairs Division, December 1991. 8p.

ABSTRACT: This report concludes that the Navy's decision to homeport its mine countermeasures ships at Ingleside will necessitate the expenditure of significant additional funds to accommodate the ships and consolidate other mine warfare forces. Ingleside's distance from the Atlantic and Pacific Fleets could also increase operational costs and hamper efforts to better integrate mine warfare forces into overall Navy operations. Further, we believe that the Navy has not adequately addressed these concerns of sufficiently analyzed the potential benefits of locating mine warfare forces at a base on both the East and West Coasts.

REPORT NUMBER: GAO/NSIAD-92-63

ACCESSION NUMBER: ADA244141

http://archive.gao.gov/t2pbat7/145526.pdf

_______. **Navy Mine Warfare: Budget Realignment Can Help Improve Countermine Capabilities**. Washington, DC: General Accounting Office, National Security and International Affairs Division, 13 March 1996. 53p.

ABSTRACT: Operation Desert Storm highlighted major weaknesses in the Navy's capability to detect and disarm enemy mines. The Navy possessed only a very limited capability at that time to conduct mine countermeasures at various water depths. In addition, two Navy warships, the U.S.S. Princeton and the U.S.S. Tripoli, both struck Thaqi mines in open waters in the Persian Gulf. The combined damage to the two ships, which totaled about $21.6 million, was caused by two mines-one estimated to cost $10,000 and the other about $1,500. The Navy has since made a number of organizational changes and initiated several research and development projects to address the weaknesses in its mine countermeasures program. At the request of the Chairman, Subcommittee on Military Research and Development, House Committee on National Security, GAO examined the steps the Navy is taking to ensure a viable, effective naval force that will be ready to conduct mine countermeasures in two nearly simultaneous major regional conflicts. Specifically, GAO evaluated the (1) status of the Navy's research and development projects, (2) readiness of the Navy's on-hand mine countermeasures assets, and (3) match between the Navy's planned and on-hand mine countermeasures assets and its mine countermeasures requirements.

REPORT NUMBER: GAO/NSIAD-96-104

ACCESSION NUMBER: ADA305721
http://handle.dtic.mil/100.2/ADA305721
http://www.gao.gov/archive/1996/ns96104.pdf

_______. **Navy Mine Warfare: Plans to Improve Countermeasures Capabilities Unclear.** Washington, DC: General Accounting Office, National Security and International Affairs Division, June 1998. 27p.
ABSTRACT: This report discusses the Navy's plans for improving mine countermeasures (MCM) capabilities; provides information on the status of current research, development, test, and evaluation (RDTE) programs; and evaluates the process the Department of Defense (DOD) used to prepare the annual certification required by Public Law 102-190.
REPORT NUMBER: GAO/NSIAD-98-135
ACCESSION NUMBER: ADA346088
http://handle.dtic.mil/100.2/ADA346088
http://www.gao.gov/archive/1998/ns98135.pdf

_______. **Navy Ships: Lessons of Prior Programs May Reduce New Attack Submarine Cost Increases and Delays.** Washington, DC: General Accounting Office, National Security and International Affairs Division, October 1994. 19p.
ABSTRACT: The Navy's plans to incorporate lessons learned from prior submarine programs, particularly the Seawolf SSN-21 program into the design and construction of the NSSN, a new class of nuclear-powered attack submarine were assessed. Several factors make the NSSN both an excellent opportunity and a challenge for the Navy to control acquisition costs and to improve the quality of the design and construction process. These factors are (1) a reduced antisubmarine warfare threat; (2) the U.S. defense budget, which has been more tightly constrained each year; and (3) the early stages of the NSSN acquisition cycle, which allow an agency to apply lessons of past programs to future programs. The NSSN's missions include battlegroup support, covert strike warfare, covert intelligence, special warfare, covert mine warfare, antisubmarine warfare, and antisurface warfare operating in both open ocean and littoral (coastal) areas.
REPORT NUMBER: GAO/NSIAD-95-4
ACCESSION NUMBER: ADA285905
http://handle.dtic.mil/100.2/ADA285905
http://www.gao.gov/archive/1995/ns95004.pdf

U. S. Naval Forces, **Vietnam Monthly Historical Supplement for January 1967**. Naval Forces, Vietnam, 20 March 67. 110p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953681

U.S. Naval Forces, **Vietnam Monthly Historical Supplement for March 1967**. Naval Forces, Vietnam, 29 May 67. 121p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953640

U.S. Naval Forces, **Vietnam Monthly Historical Supplement for April 1967**. Naval Forces, Vietnam, 3 July 67. 104p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953639

U.S. Naval Forces, **Vietnam Monthly Historical Summary for May 1967**. Naval Forces, Vietnam, 5 July 67. 51p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953638

U.S. Naval Forces, **Vietnam Monthly Historical Supplement for December 1967**. Naval Forces, Vietnam, 7 May 68. 167p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953641

U.S. Naval Forces, **Vietnam Monthly Historical Supplement for June 1968**. Naval Forces, Vietnam, 18 February 69. 185p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953598
http://handle.dtic.mil/100.2/ADA953598

U.S. Naval Forces, **Vietnam Monthly Historical Summary for January 1970**. Naval Forces, Vietnam, 10 March 1970. 197p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953634
http://handle.dtic.mil/100.2/ADA953634

U.S. Naval Forces, **Vietnam Monthly Historical Summary for April 1970**. Naval Forces, Vietnam, 13 June 1970. 138p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953608
http://handle.dtic.mil/100.2/ADA953608

U.S. Naval Forces, **Vietnam Monthly Historical Summary for June 1970**. Naval Forces, Vietnam, 17 September 1970. 111p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953607
http://handle.dtic.mil/100.2/ADA953607

U.S. Naval Forces, **Vietnam Monthly Historical Summary for July 1970**. Naval Forces, Vietnam, 22 September 1970. 75p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953606
http://handle.dtic.mil/100.2/ADA953606

U.S. Naval Forces, **Vietnam Monthly Historical Summary for August 1970**. Naval Forces, Vietnam, 6 October 1970. 90p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953605
http://handle.dtic.mil/100.2/ADA953605

U.S. Naval Forces, **Vietnam Monthly Historical Summary for September 1970**. Naval Forces, Vietnam, 8 November 1970. 87p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953604
http://handle.dtic.mil/100.2/ADA953604

U.S. Naval Forces, **Vietnam Monthly Historical Summary for November 1970**. Naval Forces, Vietnam, 9 February 1971. 94p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953596
http://handle.dtic.mil/100.2/ADA953596

U. S. Naval Forces, **Vietnam Monthly Historical Summary for May 1971.** Naval Forces, Vietnam, July 1971. 163p.
ABSTRACT: Naval actions continued to decrease in May, reaching a near standstill in four AOs and remaining very light in five AOs. However, in the TRAN HUNG DAO VI AO the activity was heavy, with an unprecedented 160 enemy slain; in the TRAN HUNG DAO IV AO the number of engagements doubled; while the TRAN HUNG DAO XVII AO, the U Minh forest campaign continued to be one of the key combat zones, accounting for 45 enemy casualties. The enemy again took recourse in sapper activity, with a drastic increase to 17 watermining incidents on the Cua Viet, including the sinking of a water taxi which caused the death of 30 civilians. Elsewhere, there were five minings in the U Minah and one on the Upper Saigon River. Enemy sappers succeeded in blowing up six POL tanks at Cam Ranh Bay on 23 May. MARKET TIME operations underwent a revision of the Inner Barrier, shifting from fixed patrol stations to the 'cloud concept' of specially formed task units patrolling in high threat areas. The U.S. Navy in-country strength continued to decline in May. As of 3 June there were 11,310 naval personnel in South Vietnam, a reduction of just less than 1000 men in the course of the month.
ACCESSION NUMBER: ADA953898
http://handle.dtic.mil/100.2/ADA953898

U. S. Naval Forces, **Vietnam Monthly Historical Summary for August 1971**. Naval Forces, Vietnam, October 1971. 132p.
ABSTRACT: Enemy overt military activity has been low in the Delta for the past two months. The current lull could be attributed to (1) a general reconsolidation of forces during which time enemy units were training, refitting, and resupplying; and (2) a renewed emphasis on political maneuvering in an effort to influence the outcome of both the Lower House and Presidential elections. It was believed that the former was successfully completed to the point where enemy assets could then be directed toward political action involving increased propagandizing, indoctrination, and proselytizing. An attempt at disrupting the Lower House elections on 29 August did not materialize in the form of overt military activity. On 17 August the SS GREEN BAY was sunk in Qui Nhon Harbor, making her the fourth major ship mined in the last 17 months, and touching off a large scale review of harbor security in all the Coastal Zones. POL stocks at the Cambodian capital reached comfortable levels, as the number of ships per convoy was doubled in July, ending for the second month in a row a POL drought.
ACCESSION NUMBER: ADA953901
http://handle.dtic.mil/100.2/ADA953901

U.S. Naval Forces, **Vietnam Monthly Historical Summary for September 1971**. Naval Forces, Vietnam, 23 November 1971. 106p.
ABSTRACT: None available.
ACCESSION NUMBER: ADA953636
http://handle.dtic.mil/100.2/ADA953636

United States Naval Mine Warfare Plan, **Third Edition**, **Fiscal Year 1996-1997 Programs**. Washington, DC: Department of the Navy, 1997. 80p.
ABSTRACT: The Third Edition of the Mine Warfare Plan: (1) Explains how U.S. Naval Forces will conduct mine warfare operations; (2) Assesses our mine warfare strengths; (3) Identifies capability shortfalls; (4) Outlines our initiatives for providing the mine warfare capabilities our naval forces will require in the 21st century. The Mine Warfare Plan also includes summaries of mine warfare technologies and the associated programs designed to meld these new technologies into the operational environments.
ACCESSION NUMBER: ADA321292
http://handle.dtic.mil/100.2/ADA321292

Van Matre, N.H. and R.J. Harrigan. **A Comparative Evaluation of Group IV Personnel Assigned to the USS Catskill: Follow-Up Performance Evaluation**. San Diego, CA: Naval Personnel and Training Research Laboratory, July 1970. 28p.
ABSTRACT: A follow-up performance evaluation was conducted on a sample of Group 4 personnel who had served 14 months aboard the mine countermeasures support ship USS CATSKILL (MCS-1). Shipboard assessments were made of the Group 4 sample and the non-Group 4 comparison sample in terms of performance test proficiency, supervisors' ratings, and other variables including rate of advancement, and disciplinary records. Results from the actual performance tests indicated no significant difference between samples in test task proficiency. The Group 4 men did score lower on a written General Navy Knowledge Test and were rated lower than the non-Group 4 personnel on two different supervisors' rating scales. The Group 4 personnel experienced more disciplinary actions, completed fewer training courses, and advanced in pay grade at a slower rate than did the non-Group 4 men.
REPORT NUMBER: SRR-71-1
ACCESSION NUMBER: AD0711298

Wallace, R. J. **Mine Warfare: Its Implication for the Future of Amphibious Operations**. Research report. August 1992-April 1993. Washington, DC: Industrial College of the Armed Forces, April 1993. 31p.
ABSTRACT: The purpose of this research paper is to explain the importance of amphibious operations in relation to the President's National Security Strategy. The barrier that may hinder our success in future regional conflicts is the amphibious mine. All Third World countries have access to these mines, which can destroy shipping lines of communications and battle plans. In today's environment, with the shrinking defense budget, I stress the requirement to continue funding mine countermeasures' programs. Funding these programs is essential to maintaining our National Security policies throughout the globe.
REPORT NUMBER: NDU-ICAF-93-S76
ACCESSION NUMBER: ADA276771
http://handle.dtic.mil/100.2/ADA276771
http://www.ndu.edu/library/ic6/93S76.pdf

Wallander, Bo L. **Electronic Countermeasures (ECM) and Acoustic Countermeasures Supported Protection for Merchant Ships Against SSM/ASM Missiles and Mines**. Master's thesis. Monterey, CA: Naval Postgraduate School, December 1989. 195p.
ABSTRACT: The necessity for merchant ship self protection has become more and more obvious during recent years. This thesis will investigate the threat (missiles and mines) and associated counter-measures that might be installed to provide a reasonable degree of protection. The results indicate that it is possible to get protection against a sea-skimming missile with a combination of ECM and ESM deployed aboard the ship. For protection against the mine threat, a sonar is designed in order to give the ship enough warning time to make an avoiding maneuver. The sonar investigation indicates the difficulty in designing a sonar that can fulfill all design objectives year-round in a complex acoustic environment.
ACCESSION NUMBER: ADA222805
http://handle.dtic.mil/100.2/ADA222805

Washburn, Alan. **Mine Warfare Models**. Monterey, CA: Naval Postgraduate School, 2005. 33p.
ABSTRACT: *None available.*
http://diana.cs.nps.navy.mil/~arwashbu/Files/MinWar.pdf

Wertman, W. H. **Cumulative Indexes of Papers from Proceedings of Minefield Conferences (I through XIV).** White Oak, MD: Naval Ordnance Laboratory, October 1971. 50p. Reprinted from NOLTR-71-71-Vol-2. This revision supersedes those previously published. It includes the papers published in NOLTR-71-71 and all previous volumes of the Proceedings.
ABSTRACT: Technical conferences have been conducted annually by the Naval Minefield Community. The Author Index and Subject Index presented list papers which have been submitted for use in connection with these conferences, and included in the Proceedings. The Proceedings include papers which were presented orally during the conference sessions, and papers on related topics which could not be presented for reasons such as absence, or limitations of the two-day conferences. Copies of the Proceedings are initially distributed upon request to individuals who furnish certifications of Secret security clearance and need-to-know in connection with conference sessions. In general, copies of individual papers included in the Proceedings are not available. Some of the papers have been published separately by the authors. Inquiries in this regard should be addressed to the authors personally or to their activities.
ACCESSION NUMBER: AD0902096

Wetzel-Smith, Sandra K. and Carl Czech. **Interactive Multisensor Analysis Training System: Using Scientific Visualization Technology to Teach Complex Cognitive Skills**. San Diego, CA: Navy Personnel Research and Development Center, August 1996. 18p.
ABSTRACT: Successful operation of airborne weapons and sensor systems demands that operators and tacticians possess high-level understanding of bow environments and potential targets interact so they may best configure onboard suites. The complex cognitive skills required can only be the product of appropriately designed training, especially when opportunities for practice are limited. The Interactive Multisensor Analysis Training (IMAT) System uses advanced scientific visualization technology to conceptually present the interactions among sensors, and environments in realistic mission scenarios. Using approved Navy, Department of Defense, and other suitable databases (e.g. DBDB-5, ANDES), IMAT computers and display systems transform the data into understandable graphic formats. As support for cognitive skill oriented training

programs, IMAT has provoked a new approach to instructional design. The IMAT approach promises to increase training efficiency and effectiveness in complex warfare areas such as anti-submarine, electronic, and mine countermeasures by accelerating the development of domain expertise and improving trainee performance during training. IMAT may also be appropriately applied to other complex cognitive skill domains inside and outside the Department of Defense, including technical training and education in meteorology, oceanography, geology, ecology, and disaster preparedness.

REPORT NUMBER: NPRDC-TR-96-9
ACCESSION NUMBER: ADA313318
http://handle.dtic.mil/100.2/ADA313318

Whitfield, Walter V. **Mine Warfare Component Coordination in Support of Operational Maneuver from the Sea.** Final report. Newport, RI: Naval War College, June 1997. 22p.

ABSTRACT: This paper analyzes the need for centralized control of all mine warfare functions at the operational level. 'Mine Warfare has become one the essential keys to unlocking the littoral battlespace. As such, we intend on putting in the hand of the Sailors and Marines who sail in support of our nation's bidding, the capabilities to defeat the mine threat, accomplish the mission, and return home safely.'

ACCESSION NUMBER: ADA328087
http://handle.dtic.mil/100.2/ADA328087
http://www.fas.org/man/dod-101/sys/ship/weaps/docs/T14htm.htm

Widmayer, Raymond S. **Strategic and Industrial Assessment of Sea Mine Warfare in the Post-Cold War Era.** Research report. August 1992-April 1993. Washington, DC: Industrial College of the Armed Forces, April 1993. 33p.

ABSTRACT: The purpose of my paper is to provide a strategic-level assessment of sea mine warfare in the post-Cold War era by addressing both government and industrial points of view. I review and summarize U.S. national security and military strategies vis-a-vis mine warfare, and I emphasize the basic roles mine warfare has the potential of playing in implementation of these strategies. The strategic role of mine countermeasures in future regional crises and contingencies is clear cut, having been unquestionably demonstrated during Desert Storm. However, the role of in is far less defined, but, as I substantiate in my paper, is also of significant strategic importance in the future. I recommend maintaining and preferably expanding the mine countermeasures program being supported by the Navy, and I recommend initiating a program to tune our mine inventory to the post-Cold War era threat. From the industrial perspective, I offer the significantly expanding mine countermeasures program as a very attractive industrial incentive. In addition, I provide several recommendations for both industry and government to help enhance the role industry can play in mine warfare in the future.

REPORT NUMBER: NDU-ICAF-93-S80
ACCESSION NUMBER: ADA276881
http://handle.dtic.mil/100.2/ADA276881

Woodward, R. L. and J. S. Mathias. **Ship Survivability Enhancement Program: Feasibility Study Report**. Ascot Vale (Australia): Materials Research Laboratories, April 1992. 50p.

ABSTRACT: This report examines the feasibility of undertaking a series of experiments and exercises, using a decommissioned Destroyer Escort, aimed at generating information that will enhance ship survivability. Consideration is given to the sites for these experiments, timing, cost and manpower implications to Navy and DSTO, and to the range of experiments to be undertaken. It is recommended that some experiments be undertaken immediately before *decommissioning and some immediately after, and that the sites at which these are to be done should be in Western Australia. The recommended experiments fall into four groups (1) Electromagnetic Transient Propagation, (2) Underwater Explosive Shock Response, (3) Weapons Effects, Fire, Smoke, Damage Control and Personnel Protection, and (4) Weapons Demonstration Firings. A program is proposed whereby each set of experiments can be accepted or rejected as a whole without influencing the others.*

ACCESSION NUMBER: ADA250320

Yang, Jackson C. S. and Robert J. Hassett. **Stress Wave Propagation in Multilayered Axisymmetric Bodies of Varying Area**. White Oak, MD: Naval Ordnance Laboratory, December 1970. 36p.

ABSTRACT: In the investigation of phenomena associated with the development of modern naval weapons, a particular problem is in the design of weapons that can withstand the impact shock of high-speed water entry and ice penetration. The purpose of this report is to report on an experimental and theoretical investigation of one-dimensional stress wave propagation in multilayered axisymmetric bodies of varying area representing shapes found in water-entry missiles and mines. An experimental investigation of elastic waves produced by the axial collision of strikers with truncated 7075 aluminum cones and conical shells with a half angle of five degrees was performed using an air gun. Strain distribution along the five-degree conical specimens was obtained by strain gages mounted on the specimen. The method of characteristics was utilized in the theoretical analysis of the propagation of elastic stress waves. Procedures of numerical integration along the characteristic directions are established and carried out for all the experimentally tested cases on a digital computer. Good agreement between the data and the results of calculations based on the analysis was obtained.

REPORT NUMBER: NOLTR-70-253
ACCESSION NUMBER: AD0881621

Zatt, David K. **Joint Operations in the James River Basin**, **1862 - 1865**. Master's thesis. Fort Leavenworth, KS: Army Command and General Staff College, 4 June 1993. 128p.

ABSTRACT: This study is an analysis of Union joint operations in the James River Basin from 1862 to 1865. Specifically the contributions made by the Union Navy during the battles of this period. It begins with an analysis of the Peninsula Campaign conducted by Major General McClellan and Rear Admiral Louis M. Goldsborough in 1862 and concludes with the Union forces entry into Richmond in April 1865. The Union Navy played a significant role in shaping the outcome of battles for control of the James River and the eventual capture of Richmond. The Navy's control of the river allowed Grant to maintain his main supply base well forward in the theater. This enabled Grant to rapidly maneuver and resupply his force. The study provides lessons on the difficulties of joint operations and the requirements to ensure success in the joint arena. Furthermore, it provides today's U.S. military with a view of riverine and mine warfare operations and the implication of allowing these warfare areas to decay.

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MINES AND MINELAYING

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ABSTRACT: In a mine of the character disclosed adapted to be planted on the bed of a body of water from a surface vessel, the combination of a mine casing, a drag plate for the mine adapted to retard the downward movement thereof as the mine descends through the water, means including a line for detachably securing the drag plate to the casing in such a manner as the cause the casing to be righted during the descent of the mine through the water, and means effective when the mine reaches a predetermined depth of submergence for disconnecting the drag plate from the casing.
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Cashman, T.M. **Striking First...Mine Warfare Goes on the Offensive**. Newport, RI: Naval War College, Joint Military Operations Department, 13 May 2002. 18p.
ABSTRACT: The indiscriminate laying of sea mines in international waters is an act of war waged by terrorist groups and non-state actors. If the United States is going to successfully counter this act of overt aggression and be successful in future conflicts which involve the illegal use of mines, it must deter the belligerent through political, diplomatic, and if necessary, physical force. History is replete with examples of the effective use of sea mines to deter, alter or counter enemy forces. In today's environment, mines have been used more as an act of terror than a

legal weapon of war. Historically, the U.S. Navy has shown a reluctance to adequately fund and appreciate the value of an aggressive countermine force. As a result, U.S. and coalition forces have been needlessly subjected to higher risks, delayed or altered battle plans and operationally limited in their course of action. Once mines are placed in the water the belligerents have gained the strategic, operational and tactical upper hand. From a time, space and force standpoint, the combination of U.S. mine countermeasures and allied forces is marginally sufficient to counter this threat and enable the naval commander the ability to effectively 'control the sea.' This should be the siren call to all naval commanders. Unless the United States leads the way in treating the indiscriminate laying of mines in international waters as an act of war, the United States and its allies will not be able to project forces ashore or control the seas without encountering considerable risks. The time is now to set the stage for new international laws regarding mine warfare, redefine rules of engagement, break down inter-service politics, educate the media, and build coalition support. The U.S. needs to muster the political will to strike first or suffer the consequences from a military and economic standpoint.

ACCESSION NUMBER: ADA405922

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Cashman, T. M. **Sweeping Changes for Mine Warfare: Controlling the Mine Threat.** Master's thesis. Monterey, CA: Naval Postgraduate School, December 1994. 86p.

ABSTRACT: This thesis proposes that the U.S. Navy deter and, if necessary, combat potential minelayers by pursuing a pro-active' offensive mine warfare strategy. Central to this proposed strategy is the development, acquisition, and use of Remote Controlled (RECO) mines. It is argued that, given the historical problems the United States has had in the area of naval mine warfare, a strategy aimed at the aggressive deterrence of enemy mine laying be embraced so as to project forces ashore in future amphibious operations.

ACCESSION NUMBER: ADA293659

http://handle.dtic.mil/100.2/ADA293659

Chernyshev, I. **Mines - A Formidable Naval Weapon (Miny - Groznoe Oruzhie Flota).** Washington, DC: Naval Intelligence Support Center, Translation Division, May 1975. 8p. Translation of **Voennye Znaniya (USSR)** no. 12, p. 41-42, 1972.

ABSTRACT: The brief article reviews the properties of Russian naval mines, mine operations, mine countermeasures and mine warfare.

REPORT NUMBER: NISC-Trans-3669

ACCESSION NUMBER: ADA012075

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Crawford, Melvin W. and Robert L. Detwiler. **Through the Ice Mining Study**. Final report. Gaithersburg, MD: Epoch Engineering Inc., June 1983. 71p.

ABSTRACT: A search for literature relevant to ice penetration by naval mines has shown that interest in the problem has existed since 1952. Early studies were followed by Arctic sea ice penetration tests using instrumented penetrators of varying sizes and weights. Empirical equations for prediction of ice penetration and longitudinal accelerations during ice penetration were originally developed by modification of earth penetration equations. Analysis of all available test data has validated the empirical equations within the originally stated limits of accuracy. Comparable test data appear to confirm the validity for structural tests of penetration testing in gypsite as a simulation of Arctic sea ice for the first few feet of penetration. Very little information exists concerning transverse acceleration and loading in either ice or gypsite. Parametric studies of mine design parameters for a typical moored mine with practical constraints show trends of the weight area factor relationship and the nose shape factor relationship to maximum thickness of *ice perforation capability, the payload to penetration relationship and the weight efficiency of the payload in a constrained total weight system. The few data available suggest that the problem of structural survival of transverse loads may be far more severe than that of surviving the longitudinal deceleration forces.*

ACCESSION NUMBER: ADA174310

http://handle.dtic.mil/100.2/ADA174310

Dill, Robert F. **The Burial and Scouring of Ground Mines on a Sand Bottom**. Research report for period ending 1 January 1958. San Diego, CA: Navy Electronics Laboratory, September 1958. 35p.

ABSTRACT: This report presents information derived from a study of scour and other environmental processes affecting a mine or other foreign object placed on a sand bottom. Because scour plays an important role in mine burial, the extent and rate of the scour process were emphasized in the study. Special attention was given to the variation of scour with water depth; scour relationship to bottom currents; the effect of object shape on scour development; the movement, if any, of objects placed on the sea floor; and the function of sediment grain size within the range commonly classified as sand in the Wentworth scale of sediment sizes (median diameters 0.062 mm to 2.000 mm).

ACCESSION NUMBER: ADA063560

Doelling, N., et al. **Autonomous Underwater Systems for Survey Operations**. Cambridge, MA: Massachusetts Institute of Technology, Sea Grant College, January 1989. 89p.

ABSTRACT: An autonomous underwater vehicle that can be released at sea, find a harbor, perform a task, and return to a designated location is highly desirable. The military applications of such a system are obvious. Mine clearing and mine laying come to mind. Other applications could include oceanographic surveys, mineral exploration, fish population studies, and underwater equipment repair. In 1987, The Naval Surface Weapons Center (NSWC) posed the development of such a vehicle as a research problem, and asked the NOAA Office of Sea Grant to recommend several Sea Grant Institutions with expertise in AUVs to investigate. MIT Sea Grant was invited to submit a proposal and was one of three Sea Grant Programs awarded a one-year grant by NSWC. The study developed a vehicle concept and outlined a plan of research necessary for its development. The findings of the MIT research team are summarized here.

REPORT NUMBER: MITSG-89-4

ACCESSION NUMBER: PB89-187397

Dowd, Frank J. **Terrorist Mines in the United States Maritime Domain: A Credible Threat?** Newport, RI: Naval War College, 2004. 21p.

ABSTRACT: The purpose of a threat assessment is to approximate the consequences and probability of an event as accurately as possible, in order to prioritize limited resources for maximum benefit. The economic consequences of a terrorist mine attack on the United States have the potential to be enormous, but unlike a WMD attack, they would only be temporary. The damage done would be closely related to the speed of the response effort in opening the port and channels to shipping. Navy capital ships and military sealift ships enter and exit port infrequently enough to plan coordinated force protection procedures should intelligence require it. While we should never completely discount the mine threat, or Al Qaeda's capabilities, there are ways to reduce vulnerability and mitigate the consequences with the resources already allocated.

ACCESSION NUMBER: ADA422792

http://handle.dtic.mil/100.2/ADA422792

Gaffney, William Alan. **Policy Considerations for the Improvement of the United States Navy Mine Warfare Capability**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1973. 60p.
ABSTRACT: The general purpose of the report is to indicate the importance of the role of mine warfare in supporting the nation's defense policy and, ultimately, the nation's political policy. The basic problem, a lack of attention and emphasis of mine warfare on the part of persons in positions of decision in the defense establishment, is treated in the opening sections as a prelude to describe the need for such a paper. Future scenarios for mine warfare employment are developed to illustrate the importance of the mine and some of the possible areas where it may be used. This line of thought is expanded through a discussion of the weapon's value as a deterrent and as a defensive weapon. Finally, a design is offered for a future Mine Force with a much broader range of capabilities and exposure to Fleet activities.
ACCESSION NUMBER: AD0764498

Game, Carlos V. **Defensive Minefield Planning**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1989. 79p.
ABSTRACT: This thesis is concerned with the problem of constructing an optimal minefield for inflicting casualties to a naval force attempting to penetrate the field. A microcomputer based simulation program dealing with this problem is presented and permits the user to select various mine characteristics (charge weight, depth, sensitivity), number of mines, number of transitting ships and navigational error.
ACCESSION NUMBER: ADA215142
http://handle.dtic.mil/100.2/ADA215142

Gerson, Donald J. and Rudolph J. Perchal. **Sea Ice Growth in Potential Arctic Minefield Areas**. Technical note. Washington, DC: Naval Oceanographic Office, April 1973. 19p. Presented at the Technical Conference on the Naval Minefield (16th).
ABSTRACT: An empirical method of determining the date of initial ice formation using daily air temperatures is described and applied to Zubov's and Kolesnikov's equations to determine day-to-day growth in ice thickness. Several methods are used also to estimate ice drift and disintegration.
ACCESSION NUMBER: ADA049020
http://handle.dtic.mil/100.2/ADA049020

Greer, William L. 1972 **Mining of Haiphong Harbor: A Case Study in Naval Mining and Diplomacy**. Alexandria, VA: Institute for Defense Analyses, April 1997. 21p.
ABSTRACT: This paper summarizes the events leading to the U.S. mining of Haiphong Harbor in 1972, near the end of the War in Vietnam. It uses the lessons learned there to examine the implications of the use of naval mining as an element of coercive diplomacy in future conflicts.
REPORT NUMBER: IDA-D-2056
ACCESSION NUMBER: ADA355037
http://handle.dtic.mil/100.2/ADA355037

Hall, E.B. **Aircraft Drops of Reefed Parachute**, **Mk. 12 Assembled on Mine**, **Mk. 25 Mod. 1**. Dahlgren, VA: Naval Proving Ground, 29 June 1950. 10p.
ABSTRACT: Aircraft drops of reefed parachute Mk. 12 with strain gages assembled on mine Mk. 25 Mod. 1 are discussed. This test was conducted to determine the loads applied to the

reefing lines of this parachute upon opening, and to assemble the data necessary to compute distance vs. time curves for parachute openings.
REPORT NUMBER: NPG-587
ACCSSION NUMBER: AD0896230
http://handle.dtic.mil/100.2/AD896230

Hurley, William J. **Naval Mining and Technology**. Alexandria, VA: Institute for Defense Analyses, April 1997. 9p.
ABSTRACT: In April 1997, a senior panel convened at Institute for Defense Analysis (IDA) to address the future of the U.S. naval mining program. This short paper was prepared as background reading for the panel. It briefly reviews some of the pros and cons of maintaining a traditional mining capability, lists areas of advancing technology that are relevant to this warfare area, and discusses the implications of these technologies for the traditional issues.
REPORT NUMBER: IDA-D-2058
ACCESSION NUMBER: ADA355035
http://handle.dtic.mil/100.2/ADA355035

Johnson, Ellis A. and David A. Katcher. **Mines Against Japan**. White Oak, MD: Naval Ordnance Laboratory, 1974. 303p.
ABSTRACT: Contents: Mines before World War II; Sea blockade from the air; Summary of mining operations and results; Mine policy during World War II; Staff aspects of mining operations; Outer zone operations; Inner zone operations; Tactics of inner zone campaign; Requirements for new mines; The problem of countermeasures; Problems in the development of new weapons.
ACCESSION NUMBER: AD0775003

Joye, Andre M. R. **A Strategic Antisubmarine Offensive Mining Model.** Technical note. Royal Australian Navy Research Laboratory, Edgecliff, October 1980. 81p.
ABSTRACT: Mathematical models are developed to assess the effectiveness of an antisubmarine offensive mining campaign in a strategic situation. A number of mining policies and submarine policies are examined. A method for determining an optimal mining policy is described.
ACCESSION NUMBER: ADA102328
http://handle.dtic.mil/100.2/ADA102328

Kaminski, Paul G. **Affordable Naval Mine Warfare**. Washington, DC: Office of the Under Secretary of Defense (Acquisition and Technology), 11 June 1996. 9p.
ABSTRACT: This report contains information concerning naval mine warfare. The document addresses threats and future naval mine warfare issues.
ACCESSION NUMBER: ADA339429
http://handle.dtic.mil/100.2/ADA339429

Kaufman, Alfred I. **Cultural and Ethical Underpinnings of the Navy's Attitude Toward Naval Mining**. Alexandria, VA: Institute for Defense Analyses, April 1997. 11p.
ABSTRACT: This document explores the cultural and ethical reasons why the U.S. Navy has always been reluctant to develop and acquire naval mines during periods of peace but has stood ready to use them extensively in time of war.

REPORT NUMBER: IDA-D-2057
ACCESSION NUMBER: ADA355033
http://handle.dtic.mil/100.2/ADA355033

Kaufman, Alfred I., et al. **The Future of U.S. Naval Mines**. Final report. Alexandria, VA: Institute for Defense Analyses, August 1997, 17p.
ABSTRACT: This White Paper reports on the deliberations of a panel of individuals who have at some previous time held highly responsible positions in the government of the United States: The Honorable Richard Cheney, Dr. Richard L. Garvin, The Honorable John 0. Marsh, Jr., The Honorable Robert C. McFarlane, Rear Admiral John M. Poindexter, USN (Ret), Professor David Rosenberg, General William Y. Smith, USAF (Ret.), Admiral Carlisle A.H. Trost, USN (Ret), The Honorable Paul Wolfowitz, The Honorable R. James Woolsey, and Admiral Ronald J. Zlatoper, USN (Ret). This senior panel sat to consider the question of whether the United States ought to develop and maintain a modern naval mining capability. At the end of the day, the panel concluded that the United States Navy should stay in the business of naval mining. The panel recommended that an R&D program, not to exceed $30M a year, be initiated to undertake the process of creating a flexible and affordable stockpile of naval mines.
REPORT NUMBER: IDA-P-3326
ACCESSION NUMBER: ADA332909
http://handle.dtic.mil/100.2/ADA332909

Khan, Sabahat. **Iranian Mining of the Strait of Hormuz – Plausibility and Key Considerations**. Dubia Media City, Dubia: Institute of Near East and Gulf Military Analysis (INEGMA), 2010. 12p.
Abstract: This report deals with a central theme in the regional balance of power and explores the possibility of Iranian forces attempting to exercise a blockade of the Strait of Hormuz specifically through the use of naval mines.
http://www.inegma.com/reports/special%20report%204/Iranian%20Mining%20of%20the%20Strait%20of%20Hormuz.pdf

Khan, Sabahat. **Strategies in Contemporary Maritime Security: Challenges Confronting the Arabian Gulf**. Dubia Media City, Dubia: Institute of Near East and Gulf Military Analysis (INEGMA), 2010. 78p.
Abstract: This study is based on the proceedings of the Maritime Security Cooperation Conference that was organized by the Institute for Near East & Gulf Military Analysis (INEGMA) under the joint presidential Patronage of His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, and His Excellency Nicolas Sarkozy, President of The French Republic, on May 25 26, 2009, at the Armed Forces Officers Club, Abu Dhabi, on the inauguration of the French 'Peace Camp.'
http://inegma.com/download/Strategies%20in%20Contemporary%20Maritime%20Security.pdf

Krumm, Theodore G. **Mine Delivery Model: A Computer Simulation**. Monterey, CA: Naval Postgraduate School, May 1966. 420p.
ABSTRACT: The Mine Delivery Model is a Monte Carlo computer simulation of the delivery of mines in detail by ships, submarines, and/or aircraft. Inputs are of such a nature as to permit the simulated execution of any specific mining plan and the outputs provide sufficient information for subsequent evaluation of the plan by a threat assessment model. The model as programmed for the CDC 1604 Computer consists of five programs. The first two programs convert input data, the third and main program is the mine delivery simulation, the fourth program provides a detailed

printout of both inputs and game results, i.e., the calculated parameters for each mine layed accompanied by selected statistics, and the fifth program provides statistics and graphs on the distributions of the mine positions.

ACCESSION NUMBER: AD0486069

Kuhlo, Robert C. **Attacking Ships: Command and Control of Joint Antiship Operations**. Maxwell, AFB, AL: Air University, Airpower Research Institute, October 1990. 67p.

ABSTRACT: In 1910 the Navy was launching aircraft from ships and by 1923 had launched its first aircraft carrier. During World War I aircraft flew maritime patrols and conducted antisubmarine operations. In 1921 Gen. an early proponent of air power, demonstrated the effectiveness of aircraft in antiship operations by sinking three battleships at sea. During World war II the Air Force and the Navy developed a joint maritime war-fighting capability that was decisive in the Pacific. Unfortunately, this joint capability withered as the services went their separate ways following the war. However, in the last 10 years, the Air Force and the Navy have actively developed joint maritime capabilities, Strategic Air Command B-52s routinely conduct sea surveillance, aerial mine laying, and Harpoon antiship operations, with aircraft recently dedicated to conventional nonnuclear missions. Tactical forces conduct joint maritime operations with the E-3 providing airborne warning and control and a variety of fighters involved in counterair and other missions in the maritime environment. The F-16, armed with Harpoon missiles, will soon provide the latest joint antiship capability. The research report investigates command and control doctrine of the Air Force, Navy, and Joint Chiefs of Staff and contrasts how the Air Force and the Navy implement this doctrine.

REPORT NUMBER: AU-ARI-89-3

ACCESSION NUMBER: ADA227049

http://handle.dtic.mil/100.2/ADA227049

Krumm, Theodore G. **Mine Delivery Model: A Computer Simulation**. Master's thesis. Monterey, CA: Naval Postgraduate School, May 1966. 422p.

ABSTRACT: The Mine Delivery Model is a Monte Carlo computer simulation of the delivery of mines in detail by ships, submarines, and/or aircraft. Inputs are of such a nature as to permit the simulated execution of any specific mining plan and the outputs provide sufficient information for subsequent evaluation of the plan by a threat assessment model. The model as programmed for the CDC 1604 Computer consists of five programs. The first two programs convert input data, the third and main program is the mine delivery simulation, the fourth program provides a detailed printout of both inputs and game results, i.e., the calculated parameters for each mine layed accompanied by selected statistics, and the fifth program provides statistics and graphs on the distributions of the mine positions.

ACCESSION NUMBER: AD0486069

Kusumoto, Neal J. **Lost Art of Maritime Mining**. Final report. Newport, RI: Naval War College, 13 February 1995. 34p.

ABSTRACT: Maritime minefields have been employed to achieve strategic and operational objectives in the five major American wars of the 20th century. The United States has been both the miner and, most recently, the victim. Mining can strike at the heart of the enemy, take advantage of an Achilles' heel, or compensate for one's own weakness. The U.S. Navy maintains a modest inventory of mines which can be laid in volume by Navy and Air Force aircraft, or covertly by submarines. Today's operational commander faces an increasingly challenging task: tackle a diverse, changing threat with fewer forces and resources without alienating the American public. Minefields can be an integral part of the plan to achieve battlespace dominance and project power. Mining can seize the initiative through surprise, enhance mass and maneuver by achieving economy of force, and expand the commander's battlespace and timeline while *compressing those of the enemy. A minefield is a stealthy, persistent, and economical weapon which can deter without killing. Against a maritime foe, the operational commander should consider mining's strategic and operational potential when planning a major operation*.

ACCESSION NUMBER: ADA293379

http://handle.dtic.mil/100.2/ADA293379

Lanou, Robert E. and James W. Corbett. **Analysis of Mine-Drop Signatures for Rise-Time**, **Amplitude**, **and Frequency Characteristics**. New Haven CT: Yale University, Laboratory of Marine Physics, March 1953.

ABSTRACT: None Available.

ACCESSION NUMBER: AD024871

http://handle.dtic.mil/100.2/AD024871

Lindgren, Edwin D. **Impact of Mine Warfare Upon U.S. Naval Operations During the Civil War**. Master's thesis. Fort Leavenworth, KS: Army Command and General Staff College, 1994. 119p.

ABSTRACT: This study investigates the impact of Confederate naval mine warfare against the operations of the U.S. Navy during the Civil War. Mine warfare was a cost effective method for the Confederacy to defend its long coastline and inland waterways. A wide variety of fixed, moored, and drifting mines were deployed and used with effect at locations along the Atlantic coast, the Gulf coast, and along rivers, including those in the Mississippi basin. Despite loss and damage to thirty-five Union naval vessels, mine use had virtually no strategic impact upon the course of the war. At the operational level, effects were apparent. Federal naval operations at Charleston and on the Roanoke River were frustrated, in large part because of the mine threat. The impact of mines was great at the tactical level. These cost effective weapons caused delays in Union operations, resulted in involved countermine operations, and caused fear and apprehension in crews. The lessons from the mine warfare experience of the Civil War are still applicable in today's warfare environment. Naval mines are a preferred weapon of minor naval powers and the U.S. Navy will be required to deal with this threat when operating in the World's coastal regions.

ACCESSION NUMBER: ADA284553

http://handle.dtic.mil/100.2/ADA284553

Mason, Gerald A. **Operation Starvation**. Maxwell Air Force Base, AL: Air University, Air War College, 2002. 21p.

ABSTRACT: More than 1,250,000 tons of shipping was sunk or damaged in the last five months of World War II when Twenty-first Bomber Command executed an aerial mining campaign against Japan known as Operation STARVATION. Despite this outstanding success, the decision to commit the still unproven B-29 to minelaying was a close one that rose to the highest levels of the Services. The decision to conduct Operation STARVATION was made not only because mining would lead to a Japanese surrender without the need for a costly invasion of the home islands, but also with an eye towards post-war roles and missions for the Air Force. Once the decision was taken, General Curtis LeMay and his Twenty-first Bomber Command threw themselves wholeheartedly into the mission. On January 23, 1945, LeMay issued a general directive to the 313th Bombardment Wing to prepare for minelaying operations and on March 27, the 313th flew the first of over 50 mining missions. Working together on the remote island of Tinian, Air Force and Navy personnel turned a mission that began as an inter-service rivalry into one of the best examples of inter-service cooperation of the Pacific War. This essay will examine the decision making process that led to the use of the B-29 for aerial mining, the planning and execution of Operation Starvation, and the results of the mining campaign.

REPORT NUMBER: AU/AWC/2002-02

ACCESSION NUMBER: ADA420650
http://handle.dtic.mil/100.2/ADA420650

McElroy, Paul. **The Mining of Wonsan Harbor, North Korea in 1950: Lessons for Today's Navy**. Quantico, VA: Marine Corps College, 1999. 59p.
Abstract: Thesis: Although the future of the U. S. Navy's newly implemented "Mine Warfare Campaign Plan" is promising, the Navy could not conduct a Wonsan type operation any better today than it did in 1950. Discussion: The amphibious operation at Wonsan Harbor North Korea was a mine warfare disaster for the U. S. Navy. For five days it delayed General MacArthur's ordered assault on Wonsan to cut off the enemy retreat north and to open a second supply line to relieve the overstressed port of Inchon. Additionally, it resulted in four minesweeper's sunk and numerous personnel casualties. The Navy has directly and indirectly taken many of the lessons from Wonsan and incorporated them into its new "Mine Warfare Campaign Plan" for the 21st Century. Upon comparison with the Commander in Chief Pacific Fleet's now declassified 1950 evaluation of Wonsan and the "Mine Warfare Campaign Plan," today's Navy is still lacking in three important areas of mine warfare: logistics, officer experience, and quantity of forces. Like Wonsan, the Navy would quickly use up available spare parts in a large amphibious operation. Similarly, the Navy officer corps is not sufficiently schooled in mine warfare, which led to many of the staff planning problems at Wonsan. Finally, the quantity of mine forces today is not sufficient to conduct a Wonsan type operation. Conclusion: The Navy's plan to overcome the mine warfare challenges of a large amphibious assault, like Wonsan, are on the right track; however, it will take until the year 2010 to fully implement. In the meantime, it does not have the ability to conduct an amphibious assault in the face of mines, and will have to remain focused on achieving the ultimate readiness goal by 2010.
ACCESSION NUMBER: ADA529052
http://handle.dtic.mil/100.2/ADA529052

McShane, Steven L. **Where Are My Submarines**. Final report. Newport, RI: Naval War College, 13 February 1995. 24p.
ABSTRACT: The unique operational capabilities and employment advantages inherent to the U.S. attack submarine force provide a cost effective and highly powerful platform to the Unified Commanders for shaping their respective theaters across the entire range of military operations. Attack submarines (SSNs) offer considerable operational flexibility and firepower while fulfilling many roles including forward presence, indication and warning, anti-submarine, anti-surface, strike, mine laying, mine countermeasure and special forces insertion. Preemptive conventional strike capability is considerably more credible in an environment where the threat of nuclear weapon employment has diminished. Therefore, the SSN's formidable conventional strike capability presents a powerful force to be reckoned with by any potential adversary. Moreover, the SSN's stealth, mobility, endurance and readiness enhance its offensive potential, making the SSN uniquely the platform of choice in most forward deployed scenarios. During the Cold War our senior military leaders, when confronted with a regional crisis, would ask where their carriers were... I would argue that in today's post Cold War era, they should be asking where their submarines are.
ACCESSION NUMBER: ADA293261
http://handle.dtic.mil/100.2/ADA293261

McWhite, Peter B. and H. Donald Ratliff. **Defending a Logistics System Under Mining Attack**. Arlington, VA: Center for Naval Analyses, August 1976. 35p.
ABSTRACT: A fundamental problem in mine warfare defense is to deploy mine countermeasure resources and to route supplies so that shipping losses are minimized. The shipping losses at a port are a function of the mining attack, the quantity and duration of countermeasure efforts, and the amount shipped from the port. Models and solution algorithms

are developed in this paper to optimally apportion scarce countermeasure resources when the quantity of supplies shipped out of each port is not subject to control and for the case when one can control both flow routing and countermeasures deployment. When the shipping schedule is fixed, the models are special cases of minimum cost network flow problems. For the more general problem, an enumeration algorithm is developed and computational results presented.
ACCESSION NUMBER: ADA030454

Menarchik, Jason D. **North Korean Protective Mine Warfare: An Analysis of the Naval Minefields at Wonsan, Chinnampo and Hungnam During the Korean War**. Maxwell AFB, AL: Air University, Air Command and Staff College, 2010. 94p.
Abstract: The Russian-directed protective minefields laid at Chinnampo, Hungnam and Wonsan during the Korean War reflect the further development and lethality of Russian protective mine warfare doctrine and capability. This development is the continuation in the sophistication of protective mine warfare begun in 1854 during the Crimean War. Russian minelaying developed from simple geographic barriers to a sophisticated, integrated, shaping defense. With the addition of modern technology, to include aircraft, missiles, and the increasing sophistication of mines themselves, mine warfare will increasingly become a cheap and more lethal defense to our modern, conventional navy. Continued American ignorance and lack of appreciation for mine warfare and for how its opponents could lay mines will someday cost her dearly.
ACCESSION NUMBER: ADA539219
http://handle.dtic.mil/100.2/ADA539219
http://www.dtic.mil/dtic/tr/fulltext/u2/a539219.pdf

Miller, George Morey , III. **A Simulation Model for the Analysis of a Proposed Mine System**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1971. 37p.
ABSTRACT: This paper is a response to a proposal before the Mine Advisory Committee that there be an analytically supported development of a modern explosive mining capability for the U. S. Navy. A proposed system is described, and a model is developed to provide the means to reevaluate the system in comparison with other alternatives.
ACCESSION NUMBER: AD0722585

Mulhearn, P.J. **Mathematical Model for Mine Burial By Mobile Underwater Sand Dunes.** Canberra (Australia): Defence Science and Technology Organisation, March 2002. 31p.
ABSTRACT: An important parameter for the prediction of mine burial on impact, when a mine is first laid, is the sediment bearing strength profile. A number of nations have been developing easily deployable penetrometers for measuring bearing strength relatively quickly. The plan would be to use these in route survey operations. Previous joint experiments by TTCP (The Technical Coperation Program) nations have found that the measured bearing strength decreases as the diameter of a penetrometer increases. This effect is not currently understood, but in this report it is shown, with the help of some new experiments, that with the right penetrometer design it is possible to obtain bearing strength profiles which can be validly used for mine burial prediction. Finally a particular penetrometer configuration is recommended for navy use.
REPORT NUMBER: DSTO-TR-1285
ACCESSION NUMBER: ADA402610
http://handle.dtic.mil/100.2/ADA402610

_______. **Mathematical Model for Mine Burial By Mobile Underwater Sand Dunes.** Canberra (Australia): Defence Science and Technology Organisation, January 1996. 28p.

ABSTRACT: Buried mines in the approaches to major ports and in shipping choke points constitute a significant problem in mine countermeasures operations because they are so hard to detect. One of the burial mechanisms which occurs in some important locations is burial by mobile underwater sand dunes (also called sand waves). In this report, a new mathematical model is presented for this process and it is shown that the factors which are most critical for the time taken for a mine to become buried are current strength, dune size, and the initial location of a mine in relation to crests and troughs of a sand dune field. As current strength increases, the time taken for a mine to become buried decreases sharply. The time until burial increases as a dune's size increases and as a mine's initial distance downstream from a dune's crest increases.

REPORT NUMBER: DSTO-TR-0290

ACCESSION NUMBER: ADA307307

http://handle.dtic.mil/100.2/ADA307307

Mulhearn, P. J., et al. **Short Range Lateral Variability of Seabed Properties (With Some Notes on Larger Scale Features) Near Port Hedland**, **WA.** Canberra, Australia: Defence Science and Technology Organisation, Aeronautical and Maritime Research Laboratory, 1996. 28p.

ABSTRACT: The spatial variability of seabed sediment properties over short ranges is investigated, and it is found that, at least for sands, sediment grain size varies within a factor of square root of 2 over distances of order 100 m. Evidence is then presented that this sediment variability, found off Port Hedland, is similar to that at many other locations around the world. Hence for acoustic backscatter and mine burial models the conventional categories: very coarse, coarse, medium, fine and very fine, for sands are as precise as it is practical to be. This implies that survey methods, with, for example, acoustic sea floor classification systems, need only provide sediment grain size to this level of accuracy. It also means that, for mine-counter measures purposes, conventional survey methods can be relatively simple, and that many existing data bases are quite adequate. From underwater video footage it is clear that many important seabed features, such as shell beds, branching corals and seaweed clumps, can easily be overlooked in sea floor surveys, with either grabs or corers alone, and that this, at times, would lead to misleading conclusions concerning environmental factors relevant to mine warfare operations. A number of interesting seabed features have been observed near Port Hedland using a sub-bottom profiler and diver-operated underwater video cameras. Because so little is known in this area, it was thought these observations were worth recording, as an appendix to this report. In particular video-camera observations of some of the long, linear, underwater ridges off Port Hedland established them to be rocky reefs, rather than sand bars, as was previously thought. This changes previous perceptions of likely mine burial mechanisms off a number of Northwest Shelf ports.

REPORT NUMBER: DSTO-TN-0022; NIPS-97-12242

ACCESSION NUMBER: ADA315399

http://handle.dtic.mil/100.2/ADA315399

Niemann, K. P. **Mine Warfare Forces**. Washington, DC: Naval Intelligence Support Center,. Translation Division: 25 April 1983. 10p. [Trans. of **Soldat und Technik**, D 6323 E, n.p., v. 2, p. 62-67, February 1983.]

ABSTRACT: No abstract available.

ACCESSION NUMBER: ADA128971

Odle, John W. and John B. Parkerson. **Minefield Simulation Models.** White Oak, MD: Naval Ordnance Laboratory, April 1974. 24p.
ABSTRACT: The report describes two computer simulation models that have been developed at the Naval Ordnance Laboratory to provide assistance to minefield planners in evaluating the performance of minefields. Provision is made for dealing with varying input parameters, and primary attention is focused on studying the effectiveness of arming delays and ship count settings in preserving the threat in the presence of influence sweeping. Use of the models is explained in detail and sample results for a hypothetical minefield are exhibited.
REPORT NUMBER: NOLX-76
ACCESSION NUMBER: AD0782354

Patterson, Andrew Jr. **Experimental Study of MK 6 Acoustic System for MK 51 Controlled Mines**. New Haven CT: Yale University, Laboratory of Marine Physics, April 1952.
ABSTRACT: None Available.

_______. Study of Air-Laid Mine Water Entry Disturbances-1951-1953 at Edwards Street Laboratory. New Haven, CT: Yale University, Laboratory of Marine Physics, November 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD026997

Phipps, Thomas E. **Application of Lanchester Analysis to a Mining Campaign**. White Oak, MD: Naval Ordnance Laboratory, November 1969. 43p.
ABSTRACT: Lanchester-type equations are derived for a mine warfare campaign in which one opponent seeks to blockade the ports of another. The effects of mutual attrition of minelaying units, counter-minelaying forces, minesweepers, and target traffic (merchant shipping or submarines) are treated and conditions for victory or stalemate are derived. Only steady-state solutions of the equations are examined. These appear adequate to answer a broad range of questions about the campaign, including the effect of mine design and tactics on total investment levels needed to win. The particular advantage of this type of model is that it provides an easy, though crude, means of estimating the effect of even the most minor design and situational variables on the over-all course of the campaign. For this reason it is hoped that it can prove useful to the mine designer or tactician.
REPORT NUMBER: NOLTR-69-204
ACCESSION NUMBER: AD0866692
http://handle.dtic.mil/100.2/AD866692

Plice, William A. **Force Balance Pressure Device**. Patent. Washington, DC: Department of the Navy, February 1974, 5p.
ABSTRACT: This invention relates to a force balancing system for determining the mooring depth of an anchored mine. More specifically, the present invention provides means to automatically cause a positively buoyant mine to float at a predetermined depth no matter what the overall depth of the water may be, provided there is sufficient mooring cable to reach from the bottom to the predetermined depth of submersion of the mine.
REPORT NUMBER: PATENT: 3,789,758
http://www.uspto.gov/patft/

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 2. Study Review Summaries. Part I**. Final report. 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 485p.
ABSTRACT: Contents: Airborne ASW; Airborne AAW; Airborne attack; Environmental systems; Mining; Mine countermeasures; Ocean surveillance; Submarine ASW; Submarine attack; Surface ASW.
ACCESSION NUMBER: AD0912444
http://handle.dtic.mil/100.2/AD912444
http://www.dtic.mil/dtic/tr/fulltext/u2/912444.pdf

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 3. Study Review Summaries. Part II**. Newport Beach, CA: Ultrasystems Inc., 31 October 1972. 469p.
ABSTRACT: Contents: Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; Undersea surveillance; Amphibious assault; Reconnaissance/intelligence; Logistics; Special warfare; Airborne ASW and submarine ASW; airborne asw and surface asw; airborne asw and undersea surveillance; airborne aaw and airborne attack; airborne attack and surface aaw; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mining and mine countermeasures; mine countermeasures and navigation; Ocean surveillance and electronic warfare; Submarine asw and surface asw; submarine asw and surface asw; Submarine attack and surface asw; surface asw and surface attack; surface aaw and surface attack; Surface aaw and electronic warfare; logistics and ship support; Airborne AAW, surface aaw and electronic warfare; airborne attack, surface attack and amphibious assault; airborne attack, surface attack and special warfare; Submarine ASW, submarine attack and surface ASW; airborne asw, submarine asw, submarine attack and sea based strategic systems; submarine asw, submarine attack, surface asw and surface attack; and airborne asw, ocean surveillance, submarine asw, surface asw and undersea surveillance.
ACCESSION NUMBER: AD0912445

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 4. MOE Reviews**. Final report 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 226p.
ABSTRACT: Contents: Airborne ASW; airborne attack; Mining; Mine countermeasures; Ocean surveillance; submarine ASW; Surface ASW; Surface ASW; Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; undersea surveillance; Amphibious assault; Naval communications; Command and control; Reconnaissance/ intelligence; airborne ASW and surface ASW; airborne AAW and airborne attack; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mine countermeasures and amphibious assault; submarine ASW and command and control; submarine attack and surface ASW; submarine attack and surface attack; surface ASW and surface attack; surface AAW and surface attack; surface AAW and command and control; surface attack and amphibious assault; electronic warfare and naval communications; Logistics and ship support; airborne ASW, ocean surveillance and surface ASW; airborne ASW, submarine ASW and submarine attack; airborne AAW, airborne attack and surface AAW; mine countermeasures, command and control and navigation; airborne ASW, airborne AAW, surface ASW and surface AAW; airborne ASW, mining, submarine ASW, submarine attack, surface ASW, logistics and ship support; and airborne AAW, airborne attack, electronic warfare, naval communications, command and control, reconnaissance/ intelligence, logistics and special warfare.
ACCESSION NUMBER: AD0912446

http://handle.dtic.mil/100.2/AD912446

Russell, Bruce F. **Operational Theater Mine Countermeasures Plan: More Than a Navy Problem**. Monograph. Fort Leavenworth, KS: Army Command and General Staff College, 14 May 1995. 54p.

ABSTRACT: This monograph finds that theater commanders, with vital maritime choke points/canals in their theater, should have their J-5 planners develop and integrate a comprehensive counter mine plan into the theater's campaign plans. In the past, regional mine countermeasure's plans have been viewed as a Navy responsibility. However, today's theater commander may face short regional conflict warning times which require the conduct of mine countermeasures (MCM) operations before Naval MCM planners and their forces (ships and aircraft) can arrive in theater. Using joint theater forces (Army, Air Force, Special Operations Forces, Navy, and Space assets), the theater commander can conduct MCM operations to prevent mines from going in the water or to detect and record locations of enemy mine laying operations, reducing greatly the time required for counter mine operations by Naval MCM ships and aircraft upon their in-theater arrival. The coordination and allocation of Joint theater forces to conduct MCM operations requires a theater commander to plan and prepare for mining threats long before the first enemy sea mine enters the water. This monograph uses the Secretary of Defense's October 1993 Report on the Bottom-Up Review as a reference, to identify real world MCM missions from a scenario that involves two nearly simultaneous conflicts in the Korean and Persian Gulf regions. To execute counter mine missions in these theaters, the J-5 planning staffs must develop MCM plans for the theater commander. This monograph takes the J-3 planner through the required building blocks to develop an effective theater MCM plan. The monograph describes the North Korean and Iraqi mining threats, past and present, to include mine types, mine delivery platforms, and possible battlespace areas that could be effectively mined. The strengths and weaknesses of U.S. MCM forces, ships and aircraft.

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http://handle.dtic.mil/100.2/ADA301152

Thomas, Marc J. **Missing from the Toolbox: Preemptive Strike**. Final report. Newport, RI: Naval War College, 16 May 1995. 21p.

ABSTRACT: The national security strategy of the United States requires the military to prosecute two nearly simultaneous major regional conflicts. This is similar to the Israeli asymetric strategy of fighting one enemy white holding another. Once the first is defeated, Israeli attention focuses on defeating the second enemy. To make the strategy work, the Israelis pre-emptively strike their enemies to gain the initiative. American national strategy does not include a provision for preemptive action. Past American wars, including the Persian Gulf War, relied on a significant build-up of regional combat power before taking offensive action. An enemy might conclude that the best way to fight the United States is to isolate the region from the introduction of U.S. forces. A combination of sea mines and an anti-air lift plan could keep U.S. forces from a theater. Because sea mining is likely to be part of an initial enemy action, preempting sea mining operations is as important as gaining air superiority. Once the sea mines are planted, will take significant time to conduct mine counter-measures operations. An enemy with a clearly defined objective and good diplomatic initiative could use the time that the U.S. was isolated from the theater to gain a peace on its terms.

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Wertman, W. H. **Cumulative Indexes of Papers from Proceedings of Minefield Conferences (I through XIV).** White Oak, MD: Naval Ordnance Laboratory, October 1971. 50p. Reprinted from NOLTR-71-71-Vol-2. This revision supersedes those previously published. It includes the papers published in NOLTR-71-71 and all previous volumes of the Proceedings.

ABSTRACT: Technical conferences have been conducted annually by the Naval Minefield Community. The Author Index and Subject Index presented list papers which have been submitted for use in connection with these conferences, and included in the Proceedings. The Proceedings include papers which were presented orally during the conference sessions, and papers on related topics which could not be presented for reasons such as absence, or limitations of the two-day conferences. Copies of the Proceedings are initially distributed upon request to individuals who furnish certifications of Secret security clearance and need-to-know in connection with conference sessions. In general, copies of individual papers included in the Proceedings are not available. Some of the papers have been published separately by the authors. Inquiries in this regard should be addressed to the authors personally or to their activities.

ACCESSION NUMBER: AD0902096

MINESWEEPERS AND MINESWEEPING

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Wiegert, Roy, Brian Price and Jalal Hyder. "Magnetic Anomaly Sensing System for Mine Countermeasures Using High Mobility Autonomous Sensing Platforms." IN **OCEANS 2002**, **29-31 October 2002**. v. 2. Biloxi, MI: Marine Technology Society, 2002, p. 937-944.

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DOCUMENTS, THESES AND TECHNICAL REPORTS

Adkins, Arthur A. and David P. Burnette. **Solving the Mine Countermeasures Problem: A Matter of Focus and Priority**. Newport, RI: Naval War College, Center for Naval Warfare Studies, May 1996. 36p.

ABSTRACT: This document reviews mine countermeasure operations and how they impact on current national security and national military strategies as well as service doctrine. It recognizes that shortfalls in dealing with sea mines still exist and recommends where resources should be focused in order tackle the most serious challenges facing future naval operations.

REPORT NUMBER: NWC/CNWS-RR-1-96

ACCESSION NUMBER: ADA309750

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Ahn, So W. **Neutralization of Surf Region Mines**. Trident scholar project report. Annapolis, MD: Naval Academy, 9 May 1995. 124p.

*ABSTRACT: There is significant military interest in the dynamic behavior of a net array of circular cylinders traveling through a fluid medium. Although research has been conducted on a towed single line configuration in water, there is little information regarding the dynamic behavior of a towed net configuration. This investigation examined the effect that physical geometry, tow velocity, and tow angle- of-attack had on the lift and drag acting on a net towed in water. The measurements indicate a significant relationship between these factors and the stability of the net, and also provide normalized polynomial equations which will be useful in predicting the aero-**ballistics of the net.***

ACCESSION NUMBER: ADA299408

http://handle.dtic.mil/100.2/ADA299408

Akyol, Kadir. **Hardware Integration of the Small Autonomous Underwater Vehicle Navigation System (SANS) Using a PC/104 Computer**. Monterey, CA: Naval Postgraduate School, March 1999. 165p.

ABSTRACT: At the Naval Postgraduate School (NPS), a small AUV navigation system (SANS) has been developed for research in support of shallow-water mine countermeasures and coastal environmental monitoring. The objective of this thesis is to develop a new version of SANS, aimed at reducing size and increasing reliability by utilizing state-of-the-art hardware components. The new hardware configuration uses a PC/104 computer system, and a Crossbow DMU-VG Six-Axis Inertial Measurement Unit (IMU). The PC/104 computer provides more computing power and more importantly, increases the reliability and compatibility of the system. Replacing the old IMU with a Crossbow IMU' eliminates the need for an analog-to-digital (A/D) converter, and thus reduces the overall size of the SANS. The new hardware components are integrated into a working system. A software interface is developed for each component. An asynchronous Kalman filter is implemented in the current SANS system as a navigation filter. Bench testing is conducted and indicates that the system works properly. The new components reduce the size of the system by 52% and increase the sampling rate to more than 80Hz.

ACCESSION NUMBER: ADA362203

http://handle.dtic.mil/100.2/ADA362203

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Anderson, Brendon and Gary Campanella. **Development of a Maneuvering Model for the RAN Precursor Mine Sweeping Drone Boat**. Ascot Vale (Australia): Materials Research Laboratories, January 1994. 27p.
ABSTRACT: A three-degree-of-freedom mathematical model has been developed to describe the zigzag maneuvering behavior of a prototype hull form used in the Royal Australian Navy precursor mine sweeping drone boat. The model predicts the yaw rate of the vessel in response to the angle of thrust that a single outboard motor makes with respect to the center line of the boat. The outboard motor is assumed to supply a constant thrust. This report describes the development of the model from first principles and its transformation into a form suitable for use in closed loop control modeling. The coefficients of the model were determined using full scale maneuvering data for the prototype hull form.
ACCESSION NUMBER: ADA279249
http://handle.dtic.mil/100.2/ADA279249

Andrus, Alvin F. and Patricia R. Hoang. **A Mine Sweeper Computer Simulation**. Technical report/Research paper. Monterey, CA: Naval Postgraduate School, February 1966. 60p.
ABSTRACT: A probabilistic computer simulation, constructed under very simplifying assumptions, of mine sweeper operations is presented. The model is described along with its associated input and output formats. A listing of the CDC FORTRAN-60 program and a sample output from several computer runs are included. The model was constructed as a pedagogical tool in an attempt to familiarize beginning students of Operations Research with the Monte Carlo method as applied in computer war gaming.
ACCESSION NUMBER: AD0629351

Blanton, Stephen Dwight. **A Study of the United States Navy's Minesweeping Efforts in the Korean Navy**. Master's Thesis. Lubbock, TX: Texas Tech University, 1993. 134p.

Blumenberg, Michael A. **Analysis of Explosive Ordnance Disposal Support Facilities Aboard the AVENGER (MCM-1) Class Ships**. Washington, DC: Naval Sea Systems Command, December 1991. 96p.
ABSTRACT: The United States Navy's AVENGER Class mine countermeasures ships are designed with facilities to support an explosive ordnance disposal detachment. However, the design and use of these facilities has not been endorsed by either the United States Navy's explosive ordnance disposal community, mine warfare community or crews of the AVENGER Class ships. This research paper investigates the above circumstances by discussing the missions and capabilities of an explosive ordnance disposal detachment and the MCM-1 Class ships in mine countermeasures operations. This study will conclude by recommending a definitive relationship between explosive ordnance disposal detachments and the AVENGER Class ships for mine countermeasures operations, including recommendations for actions necessary to achieve this relationship.
ACCESSION NUMBER: ADA331928
http://handle.dtic.mil/100.2/ADA331928

Boboltz, Jr., David A. **USS AVENGER (MCM 1) Standardization**, **Locked Shaft**, **and Trailed Shaft Trials**. Bethesda, MD: Naval Surface Warfare Center, Carderock Division, Ship Hydromechanics Department, May 1992. 77p.
ABSTRACT: Standardization, Trailed Shaft, and Locked Shaft Trials were conducted on USS AVENGER (MCM 1) to develop baseline speed and powering characteristics for the MCM 1 class

minesweepers. The trials were performed off the west coast of St. Croix, U.S. Virgin Islands from 19 to 22 June 1989 as part of NAVSEA First of Class Performance Trials. During the Standardization Trial a maximum speed of 13.92 kn at 181.7 r/min average shaft speed was achieved with the propellers at nominal 100% of design pitch. To achieve this speed, AVENGER required 2,050 total shaft horsepower (1,530 kW), with 59,300 ft-lbf total torque (80,300 N-m) applied to the shafts. The maximum speed achieved during the Locked Shaft Trial was 9.13 kn with the port shaft driving the ship at a shaft speed of 167.2 r/min. At this speed the AVENGER used 970 hp (720 kW) and 30,400 ft-1bf of torque (41,200 N-m) on the driving shaft. During the Locked Shaft Trial, the pitch on the port propeller was at nominal 100%, while the pitch on the locked starboard shaft propeller was nominal 15%. For the Trailed Shaft Trial a maximum speed of 10.34 kn was achieved at 168.5 r/min shaft speed on the driving port shaft. This speed was accomplished with 980 hp (730 kW) and 30,300 ft-1bf torque (41,100 N-m) on the driving shaft. During the Trailed Shaft Trial nominal 100% pitch was used on the port propeller with the starboard propeller trailing at nominal 1 10% pitch, Baseline standardization, trailed shaft, and locked shaft curves are also developed for the AVENGER in this report.

ACCESSION NUMBER: ADA253966
http://handle.dtic.mil/100.2/ADA253966

Borden, Steven A. **Mine Countermeasures: A Comparative Analysis of US Navy Mine Countermeasures 1999 vs. 2020**. Carlisle Barracks, PA: Army War College, 10 April 2000. 41p.

ABSTRACT: The intent of this project is to complete a comparative analysis of current US Navy Mine Countermeasures capabilities versus projected capabilities in 2020. Following a historical background, this paper will review the current force structure, its capabilities and how this force operates. It will describe proposed changes to the force and alternative concepts of operation for the 2020 timeframe. Additionally, it will relate the impact of future mine countermeasures capabilities to the ability of naval forces to conduct operational maneuver from the sea and the impact to strategic sealift timelines.

ACCESSION NUMBER: ADA377403
http://handle.dtic.mil/100.2/ADA377403

Bradley, Stephen C. **Clearing the Vital Choke Points in the Sea Lines of Communication-Its Not Just a Navy Problem and Solution**. Newport, RI: Naval War College, 1993.

ABSTRACT: This paper is primarily a thought process. Many scholarly works and group efforts have pointed clearly to the abysmal condition of the United States Naval Mine Countermeasures (MCM) both in capability and size. The problems which the U S Navy has in this capability stem from two reasons: first, an historic lack of effort in funding a robust MCM capability, and second, there are limitations in the laws of physics which make detection of mines a difficult process. The purpose of this paper is not to split the arrow which has already landed in the center of the Navy's MCM forces, but to stimulate the reader to not view MCM as the Navy problem. There are no quick solutions to the problems. However, the operational commander who reviews the entire process of mine warfare and its countermeasures has a better chance of employing and assisting a Naval force in dealing with this threat. There are two purposes to this paper- first is to show that MCM operations are not just minesweeping/minehunting; second is to suggest that Army, Air Force, and Marine forces may be very useful in keeping the vital choke points in the Sea Lines Of Communication(SLOC) open against Naval mines.

ACCESSION NUMBER: ADA266702
http://handle.dtic.mil/100.2/ADA266702

Broughton, David S. **Application of the Analysis Phase of the Instructional System Development to the MK-105 Magnetic Minesweeping Mission of the MH-53E Helicopter**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1987. 95p.
ABSTRACT: With the introduction of the MH-53E helicopter as a platform for airborne mine countermeasures, a new cockpit flight simulator was proposed. This simulator, device 2F141, will provide the U>S> Navy with the capability to simulate the flight environment of an airborne mine countermeasures mission. The method of the Instructional System Development (ISD) model was applied as a framework for development of a training program. This study concentrated on the analysis phase of the ISD process. Through the application of a task analysis and quantification methodology of the Mission Operability Assessment Technique (MOAT) a rank ordering of subtasks and major flight segments for the ship-based MK-105 magnetic minesweeping mission was determined. This study found that the major flight segments of landing, takeoff and preparation for tow, and transit to the minefield required the most improvement to increase the mission operability and effectiveness score. Therefore, a training program should be designed and developed that will effect these improvements by utilizing the cockpit flight simulator.
ACCESSION NUMBER: ADA186282

Brunk, D. H. **Data Processing Programs for Mine Countermeasures Navigation in Operation END SWEEP**. Panama City, FL: Naval Coastal Systems Laboratory, July 1973. 45p.
ABSTRACT: Operation END SWEEP was undertaken to clear mines from the harbor at Haiphong, North Vietnam. The Raydist T hyperbolic radio navigation system was used to provide precise navigation for the mine countermeasures helicopters. Automatic data processing with WANG equipment was used to establish the navigation reference stations, to plot navigation charts and important positions, and to determine navigational accuracy. A library of 10 programs was prepared by the Naval Coastal Systems Laboratory and used in the operational area by Task Force 78. Each program and instructions for its use are described in the report, while program machine code listings are contained in the supplement. The data processing equipment and programs performed very satisfactorily.
REPORT NUMBER: NCSL-169-73
ACCESSION NUMBER: AD0912485

Brunk, D.H. **Data Processing Programs for Mine Countermeasures Navigation in Operation END SWEEP. Calculator Program Details. Supplement I**. Panama City, FL: Naval Coastal Systems Laboratory, July 1973. 134p.]
ABSTRACT: This supplement contains details of the WANG 720C Calculator programs developed to provide navigation data processing for Operation END SWEEP.
REPORT NUMBER: NCSL-169-73-SUPPL-1
ACCESSION NUMBER: AD0912486

Bushnell, Jillene Marie. **Tail Separation and Density Effects on the Underwater Trajectory of the JDAM.** Monterey, CA: Naval Postgraduate School, 2009. 88p.
ABSTRACT: The Navy is in need of an organic, inexpensive, swift method to neutralize or sweep waterborne mines. This thesis presents an alternative to current mine countermeasure technologies that fulfills this criteria-the use of the Joint Direct Attack Munition (JDAM) to clear a minefield. It updates the general, physics-based, six degrees of freedom model, STRIKE35, to

predict the three-dimensional, free-fall trajectory and orientation of a MK-84 bomb (simulating the JDAM) through a water column. It accurately predicts the final detonation position relative to an underwater mine in the very shallow water environment. Input parameters include accurate water impact speed and surface impact angle of attack. Because the model results compare well with experimental data from the Stand-Off Assault Breaching Weapon Fuze Improvement (SOABWFI) Program, we analyzed the trajectory of the weapon with structural failures. This thesis solves for the impact speed and impact angle of attack limitations to remain within the Technology Transition Agreement, the detonation location for each fuze delay setting (to include its 20% tolerance), and the trajectory changes due to different water densities. This gives strike planners a tactical decision aid to clear the minefield accurately and efficiently with existing aircraft and weapons.

ACCESSION NUMBER: **ADA514313**
http://handle.dtic.mil/100.2/ADA514313
http://edocs.nps.edu/npspubs/scholarly/theses/2009/Dec/09Dec_Bushnell.pdf

Campbell, John, et al. **Actuation Mine Simulator**. Patent. Washington, DC: Department of the Navy, February 1979. 14p.
ABSTRACT: An actuation mine simulator system which enables realistic training experience in mine sweeping operations without the danger accompanying use of live mines. The actuation mine simulator is preprogrammed to respond at predetermined time intervals to actuation by large objects such as ships. The mine simulator includes buoyant flares for signaling actuation, a tethered float having a signal beacon for facilitating recovery, and an underwater acoustic transmitter for locating the simulator at the conclusion of training exercises.

REPORT NUMBER: PATENT: 4,**141**,**295**
http://www.uspto.gov/patft/

Cashman, T. M. **Sweeping Changes for Mine Warfare: Controlling the Mine Threat.** Master's thesis. Monterey, CA: Naval Postgraduate School, December 1994. 86p.
ABSTRACT: This thesis proposes that the U.S. Navy deter and, if necessary, combat potential minelayers by pursuing a pro-active' offensive mine warfare strategy. Central to this proposed strategy is the development, acquisition, and use of Remote Controlled (RECO) mines. It is argued that, given the historical problems the United States has had in the area of naval mine warfare, a strategy aimed at the aggressive deterrence of enemy mine laying be embraced so as to project forces ashore in future amphibious operations.

ACCESSION NUMBER: ADA293659
http://handle.dtic.mil/100.2/ADA293659

Chu, Peter, et al. **Modeling of Underwater Bomb Trajectory for Mine Clearance**. Monterey, CA: Naval Postgraduate School, 2010. 13p.
ABSTRACT: The falling of a Joint Direct Attack Munition (JDAM) through a water column was modeled using a six degrees of freedom model (called STRIKE35), which contains three components: hydrodynamics, semi-empirical determination of the drag/ lift/torque coefficients (depending on the Reynolds number and the angle of attack), and water surface characteristics. To validate and verify this model, three underwater bomb trajectory tests were conducted in the Naval Air Warfare Center Weapons Division (NAWC/WD) in the middle of Indian Wells Valley, California. During the test, several JDAMs were dropped from an airplane into two frustum ponds with the same bottom diameter of approximately 30.5 m, different surface diameters (61 m, 79 m), and different depths (7.6 m, 12.1 m). High-speed digital cameras with light/pressure sensors, and a global positioning system were used to record the location and orientation of JDAMs. Model-data inter comparison shows the capability of STRIKE35, which may lead to a new

approach (breaching technology) of sea mine clearance in very shallow water (water depth less than 12.2 m, i.e. 40 ft).

ACCESSION NUMBER: ADA530592

http://handle.dtic.mil/100.2/ADA530592

Davidson, Glenn M. and Marcus G. Geiger**. Sea Minefield Neutralization by Means of a Surface Detonated Nuclear Explosion**. Final summary report. Washington, DC: Bureau of Naval Weapons, March 1955. 48p.

ABSTRACT: In order to determine the effectiveness of a surface fired nuclear weapon in the neutralization of a sea minefield, 121 naval mines of moored and ground types were laid at distances of 2000 to 15,000 ft from ground zero of Shot 4 of Operation CASTLE. The data show that there is a 95% chance that 70 to 93% of all naval mines of the following types, Mk 25-0, Mk 18-0, Mk 36-2, Mk 36-3, and USSR R-1A will be neutralized within a radius of 4500 ft from the point of detonation of a 7.0 MT surface detonated nuclear weapon when the mines are planted in water of approximately 180 ft depth. The data indicate that there is a 95% chance that 72 to 96% of all U. S. naval Mines Mk 10-9 and Mk 6-0 will be neutralized within a radius of 7000 ft or an area of 5.5 square miles from the point of detonation of a 7.0 MT nuclear weapon on the water surface when the mines are located in water of approximately 180 ft depth.

REPORT NUMBER: AEC-WT-922

ACCESSION NUMBER: AD0361834

Degaussing of Acoustic Minesweeping Gear. White Oak, MD: Naval Ordnance Laboratory, April 1942. 22p.

ABSTRACT: None Available.

ACCESSION NUMBER: AD0079141

Denning, Gary M. **Mine Countermeasures: Tomorrow's Operations -- Today's Implications**. Final report. Newport, RI: Naval War College, February 1997. 23p.

ABSTRACT: Among the most cost effective weapons available to Third World nations are naval mines. Naval mines provide a small navy with an asymmetrical means to counter a much larger and more capable navy. As the United States discerned during Desert Storm, naval mines, more than any other weapon encountered, had the potential to deny access to U.S. vital objectives, block U.S. naval power projection, and jeopardize the steady flow of sustainment. The U.S. Naval Services and its MCM force took away several lessons learned from Desert Storm. They have since responded to these lessons by restructuring MCM organization and accelerating its research and development for technological improvements. While these are key takeaways, it remains to be seen whether or not the Naval Services learned the most significant lesson: MCM operations will ultimately fail unless considered as a component of the overall campaign or operational plan. The combatant commander has the ability to correct the greatest MCM deficiency of all right now. His greatest asset to minimize the mine threat is his own operational judgment. If naval expeditionary forces are to successfully dominate tomorrow's littorals, today's combatant commander must integrate MCM operations into his standing plans.

ACCESSION NUMBER: ADA325248

http://handle.dtic.mil/100.2/ADA325248

Development of a Device for Mine-Sweeping. Covina, CA: Aerojet-General Corporation, January 1953.

ABSTRACT: None Available.

ACCESSION NUMBER: AD011201

http://handle.dtic.mil/100.2/AD011201

Development of a Device for Mine-Sweeping. Informal progress report. no. 11, 1-30 April 1953. Covina, CA: Aerojet-General Corporation, May 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD011940
http://handle.dtic.mil/100.2/AD011940

Development of a Device for Mine-Sweeping. Informal progress report. no. 9, 1-28 February 1953. Covina, CA: Aerojet-General Corporation, March 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD011202
http://handle.dtic.mil/100.2/AD011202

Development of a Device for Mine-Sweeping. Informal progress report. no. 10, 1-31 March 1953. Covina, CA: Aerojet-General Corporation, April 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD011571
http://handle.dtic.mil/100.2/AD011571

Development of a Device for Mine-Sweeping. Informal progress report. no. 14, 1 August-30 September 1953. Covina, CA: Aerojet-General Corporation, October 1953.
ABSTRACT: None Available.
ACCESSION NUMBER: AD025039
http://handle.dtic.mil/100.2/AD025039

Doelling, N., et al. **Autonomous Underwater Systems for Survey Operations**. Cambridge, MA: Massachusetts Institute of Technology, Sea Grant College, January 1989. 89p.
ABSTRACT: An autonomous underwater vehicle that can be released at sea, find a harbor, perform a task, and return to a designated location is highly desirable. The military applications of such a system are obvious. Mine clearing and mine laying come to mind. Other applications could include oceanographic surveys, mineral exploration, fish population studies, and underwater equipment repair. In 1987, The Naval Surface Weapons Center (NSWC) posed the development of such a vehicle as a research problem, and asked the NOAA Office of Sea Grant to recommend several Sea Grant Institutions with expertise in AUVs to investigate. MIT Sea Grant was invited to submit a proposal and was one of three Sea Grant Programs awarded a one-year grant by NSWC. The study developed a vehicle concept and outlined a plan of research necessary for its development. The findings of the MIT research team are summarized here.
REPORT NUMBER: MITSG-89-4
ACCESSION NUMBER: PB89-187397

Donmez, Erkan. **Mine Clearance Industry: Background, Geography, Funding, Analysis and Future Projections.** Monterey, CA: Naval Postgraduate School, 2007. 349p.
ABSTRACT: Contrary to common belief, the problems caused by landmines or other counter mobility devices have been threatening the lives of human beings for thousands of years. However, the actual efforts to remove the buried mines are a comparatively new issue. The mine clearance industry has been growing steadily, mostly because of increasing demand from the mine-afflicted countries, NGOs, international organizations and the wealthy donor countries

having financial resources to attract the growing industry. The imbalance between the supply and the demand, and the financial constraints of mine-afflicted countries, NGOs, and international organizations make the efforts much more difficult to deal with. Due to these challenges faced by the stakeholders, a thorough review of the current system and prevalent shortfalls needs to be addressed. This study tries to cover the background of the problem, geography of the mine contamination, funding mechanisms, dynamics of the organizations dealing with the problem, efforts to achieve a mine-free world and recommendations for solution of the problem in the future. The mine clearance industry has also been thoroughly analyzed by using Porter's Five Forces Analysis, considering the governments of mine-afflicted countries, NGOs, International organizations, commercial clearance firms, and the donor countries having financial resources.
ACCESSION NUMBER: ADA475941
http://handle.dtic.mil/100.2/ADA475941
http://edocs.nps.edu/npspubs/scholarly/theses/07Dec%5FDonmez%5FMBA.pdf

Drezigue, de**. The Evolution of Minehunting in France (L'Evolution de la Chasse aux Mines en France**). Washington, DC: Naval Intelligence Support Center, Translation Division, July 1983. 14p. Translation of **Cols Bleus (France)** September 1982, p. 4-8, by Robert Augelli.
ABSTRACT: None Available.
REPORT NUMBER: NISC-TRANS-7128
ACCESSION NUMBER: ADA132532

Eaton, D. **Canadian Underwater Mine Apparatus: Unmanned Performance Validation of the Second Prototype Second Stage Regulator.** DCIEM technical report no. 89-TR-44. Downsview (Ontario): Defence and Civil Institute of Environmental Medicine, c1989. 15p.
ABSTRACT: The Canadian underwater mine apparatus (CUMA) provides life support for a mine-countermeasures diver to depths of 80 m of seawater (msw). The design of the CUMA produces a breathing gas with constant oxygen partial pressure by mixing pure oxygen with a diluent, either nitrogen for diving to depths of 55 msw or helium for depths of 80 msw. A reliability test of the gas-mixing circuit, two manned evaluations of the CUMA, and a field trial proved that the gas-mixing circuit worked as desired. However, a crucial component in the diluent circuit, the second stage regulator, needed technical improvements to increase its compatibility with saltwater and helium. Changes were made and a test protocol was designed to evaluate the output characteristics, and to some extent the reliability, of the new regulator. This document describes the results of a series of tests performed to establish the linearity of the regulator, the coefficients of the regression line, and the repeatability of the relationship.
ACCESSION NUMBER: MIC-92-06167

Eaton, D. J. and S. A. McDougall. **Project Review of the Experimental Diving Unit**. Semi-annual report November 1993-April 1994. Downsview (Ontario): Defence and Civil Institute of Environmental Medicine, June 1994. 46p.
ABSTRACT: Two projects in EDU, development of a freeze-proof regulator and decompression tables for the Canadian Underwater Mine-countermeasures Apparatus (CUMA), continue to occupy the majority of the unit's time. Regulator development involved iterative testing and modification of two prototypes while two, four-week dive series were completed to add 173 more human exposures to the data base required to validate the CUMA decompression model and tables. The development of an integrated system of equipment for mine-countermeasures diving integrated well with the CUMA decompression table validation. During each dive series components, such as new weight harness prototypes or dry suit samples, were included in the dives so that development could continue in parallel with the table validation. Another project

which dovetailed well with the CUMA decompression work was the development of the hand heating system under the Clearance Diver's Supplementary Heat project. Prototypes were evaluated during the CUMA decompression dives. This project has expanded to include whole body heating and electric suits for this purpose were obtained to compare their performance against the standard hot water suit.

ACCESSION NUMBER: ADA284183

http://handle.dtic.mil/100.2/ADA284183

Edlow, Sabrina R. and Julia D. Thibault. **Mainstreaming Mine Warfare and the Transition to Organic MCM Capabilities: Implementation Plan.** Alexandria, VA: Center for Naval Analyses, 2000. 35p.

ABSTRACT: *The Navy is undertaking an ambitious program to incorporate organic mine countermeasure (MCM) capabilities into the fleet and to mainstream mine warfare.*

Edwards, James K. **Assessment of Shallow Water Influence Minesweeping System (SWIMS) Implementation Utilizing CH-60**. Monterey, CA: Naval Postgraduate School, December 1999. 113p.

ABSTRACT: The Sikorsky H-60 airframe is planned to be the only rotary wing aircraft in the Navy's inventory through 2015. The CH-60 variant will support the Airborne Mine Countermeasures (AMCM) mission, replacing the current MH-53E and its MK-106 towed influence system. The CH-60's towing capacity will be significantly less than the MH-53E, so new equipment, designated the Shallow Water Influence Mine Sweeping (SWIMS) system. Capability of SWIMS is expected to be significantly less than that of the MK-106 system. Smaller size and aircraft commonality will enable SWIMS to deploy on most surface combatants, providing forward presence and reducing employment time of an AMCM suite into a Mine Danger Area (MDA). The purpose of this study is to analyze the feasibility of, and the trade off possibilities for, different types of AMCM operations using the CH-60 and SWIMS system. Given the planned limited capabilities of the CH-60/SWIMS system relative to the MH-53E/MK-106 system, we explore methods for determining; (1) how to operate CH-60/SWIMS using proposed new employment methods, (2) how many CH-60's will be required to clear a specified MDA, and (3) how to minimize the operational impact to the ships involved.

ACCESSION NUMBER: ADA374082

http://handle.dtic.mil/100.2/ADA374082

http://edocs.nps.edu/npspubs/scholarly/theses/99Dec_Edwards.pdf

Eisenberg, P. **Research at the Hamburgische Schiffbau Versuchsanstalt Relating to Pressure Actuated Mines**. Technical report Naval Technical Mission in Europe, October 1945. 135p.

ABSTRACT: None available.

ACCESSION NUMBER: ADA953462

http://handle.dtic.mil/100.2/ADA953462

Elischer, P. and J. Howe. **Australia's Shock Testing Capability.** Canberra (Australia): Defence Science and Technology Organisation, 11 February 1993. 9p. [Proceedings from the Institution of Engineers, Australia Dynamic Loading in Manufacturing and Service Conference Held in Melbourne, Victoria on 9-11 February 1990.]

ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the

successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP), minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program and the various research tasks undertaken by DSTO. This paper presents an overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water.
ACCESSION NUMBER: ADA268334
http://handle.dtic.mil/100.2/ADA268334

_______. **Dynamic Loading in Manufacturing and Service: Australia's Shock Testing Capability.** Ascot Vale (Australia): Materials Research Laboratories, 11 February 1993. 9p.
ABSTRACT: Australia's involvement in shock testing to evaluate the structural response of Naval vessels and ships' equipment to transient dynamic loads began in late 1970. It commenced with gaining the necessary understanding of underwater blast phenomena and culminated in the successful shock testing of an Australian designed and constructed, glass reinforced plastic (GRP) minehunter. Since then we have maintained an active role in conducting full scale shock trials to evaluate the vulnerability of vessels and equipment supporting mine countermeasure operations. We also conduct smaller scale trials to support the submarine construction program and the various research tasks undertaken by DSTO. An overview of the shock trials conducted to date, together with a brief description of facilities available and considerations which needed to be addressed when conducting such tests in shallow water is presented.
ACCESSION NUMBER: ADA268334
http://handle.dtic.mil/100.2/ADA268334

Fambroo, III, Dillard H. **A Combat Simulation Analysis of the Amphibious Assault Vehicle in Countermine Operations**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1999. 74p.
ABSTRACT: The purpose of this thesis is to evaluate the effectiveness of an Amphibious Assault Vehicle (AAV) as a mine countermeasure in the surf zone and beach zone (sz/bz). In order to show the utility of these approaches, this thesis presents results from three different scenarios. Scenario one provides a baseline and is conducted with the amphibious landing force moving onshore with no minefield breaching operations being conducted. Scenario two encompasses a more traditional method of minefield breaching. Scenario three will use AAVs only to breach the surf zone and beach zone minefields. The focus will be placed on the number of mines neutralized as well as the number of assets killed.
ACCESSION NUMBER: ADA370835
http://handle.dtic.mil/100.2/ADA370835
http://edocs.nps.edu/npspubs/scholarly/theses/99Sep_Fambroo.pdf

Feldes, Waldemar and Volker Hausbeck. **TROIKA**, **The West German Navy's New Mine Countermeasures System (TROIKA**, **das neue Minenabwehrsystem der Marine).** Washington, DC: Naval Intelligence Support Center, Translation Division, April 1978. 12p. Translation of **Soldat und Technik** (West Germany) no. 11, p. 600-606, 1977.
ABSTRACT: None available.
REPORT NUMBER: NISC-TRANS-4017
ACCESSION NUMBER: ADA055035
http://handle.dtic.mil/100.2/ADA055035

Focke, A. B. **Mine Countermeasures Demonstration**, **28-30 October 1968**, **Brest**. Office of Naval Research, London, December 1968. 9p.
ABSTRACT: The French and Belgian navies invited the NATO Mine Countermeasures Information Exchange Group to meet at Brest to witness demonstrations of four different types of mine countermeasures equipment. This report briefly describes the equipment and the operations performed on 28-30 October 1968.
REPORT NUMBER: ONRL-82-68
ACCESSION NUMBER: AD0845055

Fowler, Jimmy E., et al. **Cooperative Laboratory and Field Study to Investigate Effects of Wave and Current Action on Dual-Rocket Distributed Explosive Array Deployment**. Final report. Vicksburg, MS: Coastal Engineering Research Center, May 1993. 73p.
ABSTRACT: A series of 2-D (flume) laboratory and field tests were conducted to examine effects of waves and currents on a simulated dual-rocket distribution explosive array deployment (DRDEAD) system. The DRDEAD system consists of a large array of explosive material which can be deployed by rockets launched from Navy vessels across the surf zone in a mine-clearing operation. The U.S. Army Engineer Waterways Experiment Station (WES) Coastal Engineering Research Center's mid-scale 2-D facility was used to examine various wave conditions, methods of deployment, and anchoring systems for a simulated (inert) DRDEAD. Waves simulating sea state 3 conditions and lower (i.e., calm seas to 5-ft prototype waves) were used in the laboratory study. Laboratory tests indicated that sea state 3 will be a limiting condition for deployment of the array without additional weights or anchors. Field tests to assess effects of wave and current were conducted during the summer of 1992 at CERC's Field Research Facility (FRF) in Duck, North Carolina. Results of the field tests supported laboratory findings, but also indicated that longshore currents are likely to have equal or greater effects on the DRDEAD system and must be considered in the final design.... Array embedment, Explosive array, Landing craft, air cushion Buoys, Explosive array deployment, Longshore currents Coastal Engineering, Fall speed, Scaled model Research Center, Field tests Shallow Water Mine Countermeasures DRDEAD, IHDIVNAVSURFWARCEN, Program Dual-rocket distributed Indian Head Division SWMCM explosive array deployment, Laboratory tests Waterways Experiment Station Duck, North Carolina, LCAC.
ACCESSION NUMBER: ADA266082
http://handle.dtic.mil/100.2/ADA266082

Fowler, Jimmy E., et al. **Field Study on the Effects of Waves and Currents on a Distributed Explosive Array**. Final report. Vicksburg, MS: Coastal Engineering Research Center, December 1993. 82p.
ABSTRACT: Field tests to assess the effects of waves and currents were conducted during the summer of 1993 at CERC's Field Research Facility (FRF) in Duck, NC. This test series is a follow-on to similar efforts accomplished in 1992 and was designed to incorporate lessons learned from those efforts. Major differences between the 1993 tests and those conducted in 1992 involved the use of a wider array, a compressed air gun to simulate the dual-rocket deployment technique, and shore-based tethers to stabilize the deployed array. Results of the 1993 field tests generally supported 1992 findings, which indicated that both waves and longshore currents have significant effects on the explosive array deployment system and must be considered in the final design. The tests also indicated that wide arrays used in conjunction with the tethers proved to be quite stable under the environmental conditions tested.
ACCESSION NUMBER: ADA275478
http://handle.dtic.mil/100.2/ADA275478

Fowler, Robert W. **Mine Countermeasures at the Operational Level of War.** Final report. Newport, RI: Naval War College, Department of Operations, 12 November 1993. 32p.

ABSTRACT: This paper examines the complex problems and difficulties facing an operational commander when conducting operations in a mine threat environment. A discussion of mine warfare history, operational considerations, and today's mine countermeasure assets as well as a hypothetical situation that a commander may actually be faced with in today's global crisis-oriented climate is considered. The ability of the U.S. Navy to accomplish its primary strategic goal of Power Projection in a mine-threat environment is extremely difficult and limited. The panacea for present day MCM operations is recognition of the threat, knowledge of own capabilities, fleet training, and frugal management of MCM assets.

ACCESSION NUMBER: ADA265300

http://handle.dtic.mil/100.2/ADA265300

Garrigan, Robert J. **Cost Analysis of MH-53E Avionics Maintenance Support Alternatives for Remote Deployment**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1987. 64p.

ABSTRACT: The United States Navy is in the process of considering the use of Mobile Maintenance Facilities to provide an intermediate level maintenance capability to MH-53E helicopter minesweeping and mine countermeasure squadrons of four and seven aircraft while on deployment to remote locations. This thesis considers two alternatives: (1) no intermediate maintenance capability and, (2) full capability. Because of limited data only the repair of avionics components are considered. The alternative corresponding to no maintenance capability provides the increased inventory required to meet expected failures. The second alternative involves all of the elements of intermediate maintenance at a remote site as well needed supply support. Present value analyses of the life cycle costs are utilized to determine the least cost alternative. The results suggest that intermediate maintenance activities are the least cost alternative for avionics support for a seven-aircraft detachment and the most costly alternative for the four-aircraft detachment.

ACCESSION NUMBER: ADA186220

Gilbert, Jason A. **Combined Mine Countermeasures Force: A Unified Commander-in-Chief's Answer to the Mine Threat**. Newport, RI: Naval War College, Joint Military Operations Department, 5 February 2001. 26p.

ABSTRACT: The threat of mines presents a Unified commander-in-Chief (CINC) with problems affecting the time-space-force aspects of his command. Further complicating this matter, is the U.S. Navy's inability to adequately address the mine threat problem unilaterally. History demonstrates that the U.S. Navy's inability to maintain a mine countermeasures (MCM) force sufficiently large enough and technologically advanced enough has been nominally off-set by the strengths of a combined MCM force. Joint Doctrine supports the forming of alliances and coalitions, whenever possible, in order to integrate the capabilities of other nations and to promote regional stability. The complexities associated with combined forces are simplified by the characteristics and political appeal of MCM, making it attractive to the CINC and potential partner-nations. Given that mines will remain a threat complicating a CINC's ability to effectively direct the operations of his forces, and that there is a legitimate need to solve the U.S. Navy's MCM deficiencies, a CINC will be able to train as he would fight and positively influence regional stability by planning for a combined MCM force.

ACCESSION NUMBER: ADA390327

http://handle.dtic.mil/100.2/ADA390327

Gooding, Trent R. **Framework for Evaluating Advanced Search Concepts for Multiple Autonomous Underwater Vehicle (AUV) Mine Countermeasures (MCM).** Cambridge, MA: Massachusetts Institute of Technology, Department of Ocean Engineering, February 2001. 114p.

ABSTRACT: Waterborne mines pose an asymmetric threat to naval forces. Their presence, whether actual or perceived, creates a low-cost yet very powerful deterrent that is notoriously dangerous and time-consuming to counter. In recent years, autonomous underwater vehicles (AUV) have emerged as a viable technology for conducting underwater search, survey, and clearance operations in support of the mine countermeasures (MCM) mission. With continued advances in core technologies such as sensing, navigation, and communication, future AUV MCM operations are likely to involve many vehicles working together to enhance overall capability. Given the almost endless number of design and configuration possibilities for multiple-AUV MCM systems, it is important to understand the cost-benefit tradeoffs associated with these systems. This thesis develops an analytical framework for evaluating advanced AUV MCM system concepts. The methodology is based on an existing approach for naval ship design. For the MCM application, distinct performance and effectiveness metrics are used to describe a series of AUV systems in terms of physical/performance characteristics and then to translate those characteristics into numeric values reflecting the mission-effectiveness of each system. The mission effectiveness parameters are organized into a hierarchy and weighted, using Analytical Hierarchy Process (AHP) techniques, according to the warfighter's preferences for a given operational scenario. Utility functions and modeling provide means of relating the effectiveness metrics to the system-level performance parameters. Implementation of this approach involves two computer-based models: a system model and an effectiveness model, which collectively perform the tasks just described. The evaluation framework is demonstrated using two simple case studies involving notional AUV MCM systems. The thesis conclusion discusses applications and future development potential for the evaluation model.

ACCESSION NUMBER: ADA387798

http://handle.dtic.mil/100.2/ADA387798

Gould, J. W. **German Navy Moored Minesweeping**. Technical report. Naval Technical Mission in Europe. October 1945. 73p.

ABSTRACT: This report discusses the gear developed by the German Navy for moored minesweeping, This gear was limited in size by the policy of handling all gear by hand. The material for this report was obtained from the German Naval Experimental Mine Warfare Command (SVK) located in Kiel.

ACCESSION NUMBER: ADA954501

http://handle.dtic.mil/100.2/ADA954501

Griner, Joel T., Jr. **The Paradigm of Naval Mine Countermeasures: A Study in Stagnation**. Quantico, VA: US Marine Corps Command and Staff College, 1997. 73p.

Abstract: N/A

http://www.dtic.mil/dtic/tr/fulltext/u2/a529191.pdf

Harris, Daniel E. and Don W. Shepherd. **Structured Approach to the Articulation of Future Mine Countermeasure Concepts**. Panama City, FL: Coastal Systems Station, 21 March 2000. 11p.

ABSTRACT: This paper presents an approach to developing a structure derived from the point of view that mine countermeasures is a core Navy function independent of whether dedicated or organic systems and platforms perform that function. It is an appreciated fact that mine countermeasures is a complex warfare task that will play an increasingly important role in naval *operations as the Navy continues to implement the littoral warfare strategy. In the future, implementation of the naval strategy will require an expanded view of mine countermeasures. The main battle force components will be required to possess organic capabilities to deal with the threat of mines through a cooperative engagement capability approach. This paper focuses on articulating an overall framework that can be regarded as the point of departure toward defining and implementing a mine countermeasure capability fully compatible with, and integrated into, fleet operations.*

ACCESSION NUMBER: ADA376388
http://handle.dtic.mil/100.2/ADA376388

Hayes, Shaun P. **Planning the Clearance of an Open Ocean Minefield Using Two Independent Minehunting Sensors.** Honors paper. Annapolis, MD: United States Naval Academy, 2001. 25p.

HFG (Hohlstabfernraumgerat) Electromagnetic Mine Sweeping Gear. Naval Technical Mission in Europe. October 1945. 61p.
ABSTRACT: This report covers the HFG (Hohlstabfernraumgerat) magnetic minesweeping gear. This gear exists in four sizes designated by the approximate length of the float. These are the HFG 12, 15, 24 and 50. The HFG 12, 15 and 24 were developed by the Danish Navy and are patented in Denmark. Danish permission was given for their information used in this report. Recognizing the value of this sweep for rivers, canals, harbors and low salinity waters, the German Navy took it over. The HFG 50 is an independent German proposal. The material for this report was obtained from the German Experimental Mine Warfare Command (SVK) and the Danish Helsinger Shipyard.
REPORT NUMBER: TR-504-45
ACCESSION NUMBER: ADA954377

Holden, Kevin T. **Mine Countermeasures: What the Operational Commander Must Know**. Newport, RI: Naval War College, Department of Operations, 8 February 1994. 35p.
ABSTRACT: A great deal has been written concerning the need for more and improved mine countermeasures equipment. What seems lacking is adequate focus at the operational level regarding how to effectively and efficiently employ existing systems in support of current and future operations. In many situations, to achieve a military objective, it is essential the operational commander know the existing or potential mine threat, understand current mine countermeasure capabilities, determine the available courses of action, and select the course of action that will provide the highest probability of success in support of an assigned mission. This paper is intended to emphasize the importance of mine countermeasures to the operational commander. It draws upon the lessons of history to show that mine warfare has had a significant impact on naval and joint operations. while the paper addresses some technical and tactical aspects of mine countermeasures, the primary focus is on the operational considerations and options available to the operational commander.
ACCESSION NUMBER: ADA279712
http://handle.dtic.mil/100.2/ADA279712

Hong, Young S. **Improved Prediction of Drift Forces and Moment**. Final report. Bethesda, MD: David W. Taylor Naval Ship Research and Development Center, September 1983. 43p.
ABSTRACT: A three-dimensional method is developed to improve the computation of the drift force and moment for small-waterplane-area, twin-hull (SWATH) and surface ships in oblique waves with zero forward speed. Numerical results have been computed for three ships: SWATH

6A, Stretched SSP, and MCM experiment. For MCM 5371, the results of two- and three-dimensional methods are almost identical to each other and these results show good agreement with experiment when the wavelength ratio is not too small. Even though there are no test data available for SWATH 6A, the application of three dimensional theory is likely to improve the results of drift force and moment for SWATH ships.

ACCESSION NUMBER: ADA134055

Hurley, William J., et al. **General Approach to Investing in the New Modeling and Simulation Tools With A Case Study: Naval Mine Countermeasures Programs**. Alexandria, VA: Institute for Defense Analyses, July 1995. 218p.

ABSTRACT: Recent advances in computing, networking and visualization have led to dramatic improvements in modeling and simulation (MS) capabilities. The key issue for DoD is how to successfully convert these impressive technical developments into useful tools for addressing DoD's needs. This study proposes a general framework for deciding how to invest in the new MS tools. The framework begins with an articulation of a key need facing the decision maker. It then addresses the potential roles for MS in meeting that need, the implied characteristics of the MS tools, their costs, value added, risks, funding, and management. It then repeats this process for a range of needs facing the decision maker, and, by looking for common elements and setting priorities, seeks to integrate the results across all of the needs into a single MS plan. As a case study, this process is applied to the area of naval mine countermeasures (MCM). No detailed road map for MS investment is given, but the issues that arise are described along with some methods that may be used to resolve them. A strawman approach to MCM MS investments is presented. This is a 'fleet first' approach which focuses initially on training, tactical development and mission rehearsal with later applications to acquisition once acceptance of the MS tools, and confidence in them, have been established. The general framework described should be applicable to any area where the benefits and costs of the new MS tools are under consideration.

ACCESSION NUMBER: ADA305451

http://handle.dtic.mil/100.2/ADA305451

Inman, Douglas L. and Scott A. Jenkins. **Scour and Burial of Bottom Mines**. LA Jolla, CA: Scripps Institute of Oceanography, Interactive Oceanography Division, September 2002. 128p.

ABSTRACT: A process-based model was developed to predict the burial of bottom mines. The model has been validated In field experiments conducted on the near shelf off La Jolla, CA. The model was used by SPAWAR/San Diego to evaluate optimal configurations for a mine neutralization device delivered by marine mammals. The model features a coastal classification system to facilitate model initialization for 7 coastal types.

ACCESSION NUMBER: ADA406602

http://handle.dtic.mil/100.2/ADA406602

Kajuch, Jan, et al. **Process and Cost Optimization of Aluminum Stabilized NbTi Superconducting Wire Assessment of Cladding Technologies for Aluminum Stabilized NbTi Superconducting Wire**. Johnstown, PA: Concurrent Technologies Corporation, 1997. 21p.

ABSTRACT: Recent advances in the development of the aluminum stabilized NbTi superconductor have great potential for military and commercial applications such as mine sweeping and magnetic resonance imaging (MRI). Producing long, low-cost conductors requires either improving the current technology or developing new approaches to aluminum cladding and conductor forming processes. However, these cladding and forming processes should be coupled with concurrent product and process design based on material properties and simulation models. The Program Executive Office, Mine Warfare, tasked the National Center for Excellence in Metalworking Technology (NCEMT) to assess the current state-of-the-art in cladding technology *for NbTi superconductors, based on interactions with commercial companies and the Naval Surface Warfare Center (NSWC), Annapolis Detachment, and a thorough review of the technical literature. This report presents several potential commercial technologies and their advantages and disadvantages. Out of the five different approaches to aluminum cladding, extrusion and electroplating methods are the least applicable due to their batch-type operations with inherently limited conductor plating length capability. The three other methods of aluminum cladding include radial wrapping, linear wrapping, and molten metal coating. While each method has technical challenges, all three have capabilities to continuously clad aluminum for the required conductor lengths. Benefits derived from a successful aluminum cladding technology include a 40-50% weight reduction over equally sized all-copper-stabilized wire, improved thermal stability (10 times) of the magnet system, and a 25-30% decrease in manufacturing cost. Based on the evaluative efforts at the NCEMT and the NSWC, the most technically feasible and affordable method will be selected for further development.*

REPORT NUMBER: NCEMT-TR-97-047; NIPS-97-61750
ACCESSION NUMBER: ADA329391
http://handle.dtic.mil/100.2/ADA329391

Kaminski, Paul G. **Affordable Naval Mine Warfare**. Washington, DC: Office of the Under Secretary of Defense (Acquisition and Technology), 11 June 1996. 9p.
ABSTRACT: This report contains information concerning naval mine warfare. The document addresses threats and future naval mine warfare issues.
ACCESSION NUMBER: ADA339429
http://handle.dtic.mil/100.2/ADA339429

Karun, Ronald J. **Analysis of the Waterhammer Concept as a Mine Countermeasure System**. Monterey, CA: Naval Postgraduate School, September 2000. 64p.
ABSTRACT: The purpose of this thesis is to provide an analysis of the Waterhammer concept design. Waterhammer is a device intended to generate repetitive shock waves to clear a path through the very shallow water region for amphibious operations. These repetitive shock waves are intended to destroy obstructions and mines alike. This thesis analyzes the energy budget of the deflagration processes and the basic principles of shock waves and acoustic saturation. When the source amplitude is increased to very high levels, acoustic saturation sets in, a state in which the amplitude of the received signal approaches a limiting value, independent of the source amplitude. Acoustic saturation thus will set physical constraints in the design of Waterhammer. Furthermore, as the pulse propagates in the shallow water environment, reflections from the water's surface and bottom floor will spread (he energy in the water column thus reducing the energy density, These combined effects can affect the intended performance of Waterhammer. The results of the analysis in this thesis lead to the conclusion that Waterhammer may not be viable in its present concept design.
ACCESSION NUMBER: ADA384598
http://handle.dtic.mil/100.2/ADA384598
http://edocs.nps.edu/npspubs/scholarly/theses/00Sep_Karun.pdf

Kern, George E. **Mine Neutralization System**. Patent. Washington, DC: Department of the Navy, filed 22 March 1967, patented 4 December 1990. 7p.
ABSTRACT: This patent discloses a mine neutralization system having self-propelled explosive charges fired at submarine mines by a mine detection and fire control system.
REPORT NUMBER: PATENT: 4,975,888
http://www.uspto.gov/patft/

Kervern, G. **Fire-and-Forget Expendable Mine Disposal Concepts**. Thomson Sintra Activites Sous-Marines, Brest (France), 1996. 7p.
ABSTRACT: Classical minehunting operations are often divided in 4 stages: detection by sonar, classification by sonar, mine identification, and mine neutralization. Identification and neutralization are generally achieved by the same equipment: a man-guided underwater vehicle. This underwater vehicle usually performs mine identification with the help of a video camera and is designed large enough to carry a strong explosive charge capable of destroying the mine without excessive accuracy is positioning. This paper aims at proposing new concepts and scenarios of guidance according to the different kinds of minehunting sonar available, at determining the criteria for the design of acoustic sensors (with or without the cooperation of launching vessel sonars) for the guidance equipment at proposing target recognition methods, and finally at estimating probability of success for several concepts by means of software simulations. The first approach will highlight the need, as for missile design, for extended software simulations in the definition of neutralization scenarios and systems, and in performance assessments.
ACCESSION NUMBER: PB-97-130561

Kish, Louis A. **Acoustic Mine Countermeasures.** Patent. Washington, DC: Department of the Navy, filed 9 December 1963, patented 13 November 1990. 7p.
ABSTRACT: This patent discloses a mine sweeping method and related apparatus for achieving at least temporary passivation of underwater acoustic influence mines by the generation of particular underwater sounds of progressively increasing intensity. The water is acoustically pulsed by repetitively injecting into the water individual metered slugs of heated water, which water is heated to its saturation pressure but below the critical point. The metered slugs of heated water may be of the same or of progressively increasing size, i.e. weight, and can be released from a heated pressure chamber into the water from either a stationary array or from an array towed from a moving ship, and at a depth such that the expanding bubbles, produced by the change of state of the heated water, do not break the water surface. The rapid expansion of the metered slugs produce the desired sound output for temporarily rendering the acoustic influence mines passive actuating their anti-countermine circuits.
REPORT NUMBER: PATENT: 4,969,399
http://www.uspto.gov/patft/

Klug, C. A. **Development of a Device for Pressure Mine Sweeping**. Special Report. 1 December 1951-1 May 1955. Azusa, CA: Aerojet-General Corporation, September 1955.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0085690

Krauss, Henry J., Jr. **From the Sea in 1950: Lessons for the 21st Century from Operation Chromite**. Final report. Newport, RI: Naval War College, Department of Operations, 22 February 1993. 35p.
ABSTRACT: *The Navy and Marine Corps' combined vision for the 21st Century is articulated in the joint White Paper . . . . From the Sea. The focus is designed to provide a direction for the Naval Expeditionary Forces to proceed in shaping its forces in support of the National Security Strategy. The new direction is to be shaped for joint operations and structured to build power from the sea, operating forward in the littoral regions of the world. The purpose of this paper is to conduct a historical study of the United States' last major amphibious operation, with joint/combined force during a major regional conflict. Current national demobilization trends mirror the strategic culture of the late 1940s. The study of Operation Chromite: The Inchon-Seoul*

Campaign of 1950, revealed a nation ill prepared to respond to a major regional conflict due to a precipitous demobilization. The operational art employed by General MacArthur during Operation Chromite capitalized on synchronized amphibious maneuver and interdiction to attack North Korean centers of gravity. The success of the operation highlighted the importance of understanding the operational art, pursuing specialized amphibious training, and maintaining the capability of generating superior firepower. The weaknesses our Naval Service will bring into the 21st Century for a littoral Navy are insufficient naval gunfire, mine countermeasures, and amphibious lift resources.... National Security Strategy and Amphibious Operations.

ACCESSION NUMBER: ADA264284

http://handle.dtic.mil/100.2/ADA264284

Lawson, K. R. and D. D. Richardson. **Australian Mine Sweeping Game**. Technical report. Ascot Vale (Australia): Materials Research Laboratories, February 1994. 34p.

ABSTRACT: This Note describes the Australian Mine Sweeping Game (AMSG). The game represents minesweeping and enables MCM officers to become more familiar with the consequences of various sweeping tactics. The game is designed for a single Player (or a team of Players working together) and an Umpire. The Umpire can lay a minefield, selecting mines from a list of five types. The scene can be set for the Players, and their performance monitored. The Players appraise the situation, and then devise the tactics for sweeping the minefield. Hints are provided on likely mines in the field. The game will show the Players how effective the tactics they chose proved to be, by showing a simulation of the minefield being swept.

ACCESSION NUMBER: ADA279264

http://handle.dtic.mil/100.2/ADA279264

Long, Edwin T. **Manned Testing of Fullerton Sherwood SIVA 55-VSW Underwater Breathing Apparatus (UBA for Very Shallow Water (VSW) Mine Countermeasure (MCM) Missions**. Panama City, FL: Navy Experimental Diving Unit, November 1999. 32p.

ABSTRACT: Presently, no specific diving apparatus on the Authorized for Navy Use (ANU) list meets the demands set forth by the CNO to conduct very shallow water mine countermeasure (VSW MCM) operations. NEDU was tasked to test and evaluate the Fullerton Sherwood SIVA 55-VSW Underwater Breathing Apparatus (UBA) , to determine whether it will maintain a sufficient O2 fraction to support a working diver from the surface to 60 fsw (10.4 msw). Using a 30% / 70% N2 / O2 mix, NSDU personnel conducted at least 16 SIVA 55 dives each in 77 deg +/- 3 deg F (25 deg +/- 1.7 deg C) water in the 15 ft. (4.6 mew) deep NSDU test pool, and at 40 and 60 few (12.2 and 18.4 mew) in the NEDU Ocean Simulation Facility (OSF). Divers conducted manufacturer-sanctioned UBA purges on the surface and an additional purge after reaching the bottom, rested five to 10 minutes, then pedaled on underwater ergometers for 30 minutes each at 50 and 75 watts. During test pool dives, nearly a quarter of the divers' UBAs reached potentially hypoxic levels. We conducted another set of test pool dives and determined that setting the "buoyancy control valve" (BCV) half-open-vice one-quarter open during the first series-ensured adequate UBA O2 concentrations. At 40 few nearly half of the divers' UBA PO2 remained above 1.3 ATA after 10 minutes of exercise (mean = 1.34 ATA; range = 1.09 - 1.45 ATA) but, for all but one diver, dropped below 1.3 ATA within 13 minutes. Average PD: during the initial 10 minute rest period was 1.41 ATA. At 60 few we halted testing after four dives due to high PO2 levels (mean = 1.63 ATA). Because the U.S. Navy Diving Manual authorizes divers' PO2 to reach 1.4 ATA without Commanding Officer (CO) authorization- and 1.6 ATA with CO authorization-we recommend that the SIVA 55-VSW be accepted and authorized for use by the VSW MCM detachment with the following caveats: (1) Never plan dives exceeding 40 few; (2) complete a thorough UBA purge prior to entering the water and before ascending.

REPORT NUMBER: NAVSEA-TA-020

ACCESSION NUMBER: ADA371261
http://handle.dtic.mil/100.2/ADA371261

Ludwig, Peter M. **Formation Control for Multi-Vehicle Robotic Minesweeping**. Monterey, CA: Naval Postgraduate School, June 2000. 101p.
ABSTRACT: Current methods of minefield reconnaissance and clearance operations prove to be tedious, time consuming, expensive, and dangerous. In an effort to find an effective low cost solution, the U.S. Navy is considering using fleets of robotic underwater vehicles equipped with detection sensors and /or magnetic and acoustic minesweeping devices. To ensure maximum sweeping of the minefield, all vehicle movements are coordinated through a supervisor vehicle. Here, a computer simulation was conducted using a lawnmower minesweeping pattern. As the minefield is swept, vehicles are lost to mine detonations and the supervisor re- tasks all remaining vehicles. The algorithm for track control and vehicle reconfiguration was studied and evaluated.
ACCESSION NUMBER: ADA380324
http://handle.dtic.mil/100.2/ADA380324
http://edocs.nps.edu/npspubs/scholarly/theses/00Jun_Ludwig.pdf

Machado Guedes, Mauricio J. **Minefield Reconnaissance Simulation.** Monterey, CA: Naval Postgraduate School, June 2002. 60p.
ABSTRACT: The Navy plans to do covert reconnaissance of minefields with a remote underwater vehicle that includes two sensors, one long-range (LR) and one short-range (SR). LR can detect mines, but it cannot distinguish them from harmless mine-like objects. SR can tell the difference, but only by approaching to within short range. A program called MIRES (Minefield Reconnaissance Simulator) is implemented to answer the questions of how the vehicle should perform a search and to estimate the number of mines remaining in the area once the reconnaissance is over. MIRES investigates four modes of search; a planned search with departure to identify an object, a planned search with no departure, and two kinds of random search. It compares these types of search and identifies the best search mode for a given scenario.
ACCESSION NUMBER: ADA404616
http://handle.dtic.mil/100.2/ADA404616
http://edocs.nps.edu/npspubs/scholarly/theses/02Jun%5FGuedes.pdf

Mangelsdorf, John E., et al. **A Study of the Plotting and Communication Facilities in the Chart Room of UOL-Equipped Minesweepers**. Technical report. Stamford, CT: Dunlap and Associates, October 1951. 60p.
ABSTRACT: The purpose of this investigation was to determine the efficacy, from a human engineering point of view, of equipment and procedures on coastal minesweepers equipped with the Underwater Object Locater (UOL). The investigation was directed toward the principal function of these minesweepers which is to obtain positional information on mines and underwater objects.
REPORT NUMBER: SPECDEVCEN-641-3-9
ACCESSION NUMBER: AD0643205

Martin, P., et al. **Proceedings of the Ship Control Systems Symposium (5th)**, **Held at U. S. Naval Academy**, **Annapolis**, **Maryland on October 30 - November 3**, **1978.** Volume 2. Annapolis, MD: David W. Taylor Naval Ship Research and Development Center, 3 November 1978. 349p. [See also Volume 3, **ADA159083.**]

ABSTRACT: Partial contents: Ship Handling Simulator; Ship Control Centre Training Facilities for the Royal Navy; Ship Maneuverability Transducer Controlled by Mini-Computer for Training Ship - Onboard ship handling simulator; Modern Control Theory for Dynamic Positioning of Vessels; Design and Simulation of Navigation and Ship Control Algorithms for a Minesweeper; Automatic and Manual Control of the 'Tripartite' Minehunter in the Hover and Track Keeping Modes - a Preliminary design; Reversing Dynamics of a Gas Turbine Ship with Controllable-Pitch Propeller; Transient Behavior of Gasturbo-electric and Fixed Pitch Propeller; Gas-Turbine Simulation Techniques for Ship Propulsion Dynamics and Control Studies; New Ship Technical Control Systems for the Royal Norwegian Navy; Development of a Machinery Control and Surveillance System for a Mine Countermeasures Vessel; Developments in Marine Gas Turbine Condition Monitoring Systems; Optimal Control of Hydrofoil Ship Lateral Dynamics; Future Propulsion Control System Functional Requirements; and High Power Superconducting Ship Propulsion System - Its control functions and possible control schemes.

ACCESSION NUMBER: ADA159082

McKinney, C. **International Symposium on Mine Warfare Vessels and Systems Held at London**, **England on 12-15 June 1984**. Conference report. London (England): Office of Naval Research, 19 July 1984. 15p.

ABSTRACT: The International Symposium on Mine Warfare Vessels and Systems was held in London from 12 through 15 June 1984. This report discusses presentations on platforms and propulsion equipment for mine countermeasures systems, and minehunting systems and components.

ACCESSION NUMBER: ADA146408

Middlebrook, Edwin E. **A Combat Simulation Analysis of Autonomous Legged Underwater Vehicles**. Master's thesis. Monterey, CA: Naval Postgraduate School, June 1996. 83p.

ABSTRACT: Autonomous Legged Underwater Vehicles (ALUVs) are inexpensive crab- like robotic prototypes which will systematically hunt and neutralize mines en masse in the very shallow water and the surf zone (VSW/SZ). With the advent of mine proliferation and the focal shift of military power to the littorals of the world, ALUVs have the potential to fill a critical need of the United States Navy and Marine Corps mine countermeasure (MCM) forces. Duplicating the MCM portion of the Kernel Blitz 95 exercise whenever feasible, this thesis uses the Janus interactive combat wargaming simulation to model and evaluate the effectiveness of the ALUV as a MCM. Three scenarios were developed: an amphibious landing through a minefield using no clearing/breaching; an amphibious landing through a minefield using current clearing(breaching techniques; and an amphibious landing through a minefield using ALUVs as the clearing(breaching method. This thesis compares the three scenarios using landing force kills, cost analysis, combat power ashore, and percentage of mines neutralized as measures of effectiveness.

ACCESSION NUMBER: ADA314862

http://handle.dtic.mil/100.2/ADA314862

Middlebrook, Edwin E., Bard K. Mansager, and Carlos F. Borges. **Combat Simulation Analysis of Autonomous Legged Underwater Vehicles**. Monterey, CA: Naval Postgraduate School, Department of Mathematics. September 1997. 15p.

ABSTRACT: Autonomous Legged Underwater Vehicles (ALUVs) are inexpensive crab-like robotic prototypes which will systematically hunt and neutralize mines en masse in the very shallow water and the surf zone (VSW/SZ). ALUVs have the potential to fill a critical need of the United States Navy and Marine Corps mine countermeasure (MCM) forces. Duplicating the MCM portion of the Kernel Blitz 95 exercise whenever feasible, this thesis uses the Janus interactive combat wargaming simulation to model and evaluate the effectiveness of the ALUV as a MCM. Three scenarios were developed: an amphibious landing through a minefield using no clearing/breaching; an amphibious landing through a minefield using current clearing/breaching techniques; and an amphibious landing through a minefield using ALUVs as the clearing/breaching method. This thesis compares the three scenarios using landing force kills, cost analysis, and combat power ashore as measures of effectiveness.

REPORT NUMBER: NPS-MA-97-006
ACCESSION NUMBER: ADA335557
http://handle.dtic.mil/100.2/ADA335557
http://edocs.nps.edu/npspubs/scholarly/theses/NPS-MA-97-006.pdf

Molenda, Patrick A. **Organic Mine Countermeasures: An Operational Commander's Key to Unlocking the Littorals**. Newport, RI: Naval War College, Joint Military Operations Department, 5 February 2001. 27p.

ABSTRACT: This paper examines the U.S. Navy's organic mine countermeasure (MCM) concept as it pertains to the operational commander. The U.S. Navy is embarking on a MCM concept that will rely heavily on organic countermine systems tied directly to surface warships, helicopters and submarines. While organic MCM assets will offer some advantages, a close examination of the concept identifies many operational shortcomings. Specifically, the organic MCM concept will do little to assure littoral access for naval and land forces through a mined environment. The Navy hopes that as organic MCM systems mature, the need for dedicated MCM forces will decrease. This will facilitate an 'in-stride' capability for an operational commander to maneuver through mined seas. This paper shows that because of the complexity of the modern naval mine threat and the operational limitations of organic MCM deployment, a substantial dedicated MCM force will still be required to ensure maximum effectiveness in a mined operating area. Despite the sophistication of new MCM technology, mine warfare will remain a slow, tedious, and challenging discipline. Only through a prudent mix of organic and dedicated MCM forces will an operational commander be able to prevail against the formidable naval mine threat.

ACCESSION NUMBER: ADA389665
http://handle.dtic.mil/100.2/ADA389665

Morgan, K.R. and M. Fennewald. **Unmanned Testing of Fullerton Sherwood SIVA VSW Underwater Breathing Apparatus (UBA) for Very Shallow Water (VSW) Mine CounterMeasure (MCM) Mission**. Panama City, FL: Navy Experimental Diving Unit, October 1999. 20p.

ABSTRACT: In response to the continuing challenge of conducting MCM in depths between 10 to 40 fsw, the CNO has authorized the Near Term Mine Warfare Campaign Plan. This plan includes the establishment of the VSW MCM Detachment as a primary supporting unit. Presently, no specific diving apparatus on the ANU list meets the demands set forth by CNO to conduct VSW MCM operations. NEDU has been tasked to test and evaluate the Fullerton Sherwood SIVA VSW UBA to determine if it meets the stringent requirements for operating in this mission area.

NAVSEA Diving Safety Certification requirements must be met to achieve the designation of 'Authorized for Navy Use' set forth by NAVSEA 00C prior to fielding any UBA in the U.S. Navy. This report deals with the conduct of unmanned diving tests and procedures to verify functional characteristics in accordance with manufacturer's specifications and the VSW MCM UBA Performance Specification.

ACCESSION NUMBER: ADA371173

http://handle.dtic.mil/100.2/ADA371173

Morien, Steven B. **The Operational Effects of Mine Warfare**. Newport, RI: Naval War College, 5 February 1999 28p.

ABSTRACT: This paper demonstrates that naval mines are a threat to the operational commander and that there are actions he can take to reduce the operational effects of mine warfare. The first section demonstrates that mine warfare is a pertinent problem for the operational commander by examining three principle relationships. It examines the history of mine warfare from an operational perspective, warfare in the context of operational art and mine warfare in the context of the U.S. Navy and U.S. Marine Corps service visions. The second part of the paper explores the Mine Countermeasures (MCM) concept of operations, the difficulties countering the mine problem with recommendations to minimize the operational effects and lastly, the future of mine warfare in the context of "Joint Vision 2010" and beyond. This paper shows that the operational commander can minimize the operational effects of mine warfare by preventing mining, maintaining surveillance, minimizing maneuver space requirements, requesting MCM forces early in crisis, using creative schemes of maneuver and exploiting the miner's resource and environmental limitations.

ACCESSION NUMBER: ADA363227

http://handle.dtic.mil/100.2/ADA363227

Mulhearn, P. J., et al. **Short Range Lateral Variability of Seabed Properties (With Some Notes on Larger Scale Features) Near Port Hedland**, **WA.** Canberra, Australia: Defence Science and Technology Organisation, Aeronautical and Maritime Research Laboratory, 1996. 28p.

ABSTRACT: The spatial variability of seabed sediment properties over short ranges is investigated, and it is found that, at least for sands, sediment grain size varies within a factor of square root of 2 over distances of order 100 m. Evidence is then presented that this sediment variability, found off Port Hedland, is similar to that at many other locations around the world. Hence for acoustic backscatter and mine burial models the conventional categories: very coarse, coarse, medium, fine and very fine, for sands are as precise as it is practical to be. This implies that survey methods, with, for example, acoustic sea floor classification systems, need only provide sediment grain size to this level of accuracy. It also means that, for mine-counter measures purposes, conventional survey methods can be relatively simple, and that many existing data bases are quite adequate. From underwater video footage it is clear that many important seabed features, such as shell beds, branching corals and seaweed clumps, can easily be overlooked in sea floor surveys, with either grabs or corers alone, and that this, at times, would lead to misleading conclusions concerning environmental factors relevant to mine warfare operations. A number of interesting seabed features have been observed near Port Hedland using a sub-bottom profiler and diver-operated underwater video cameras. Because so little is known in this area, it was thought these observations were worth recording, as an appendix to this report. In particular video-camera observations of some of the long, linear, underwater ridges off Port Hedland established them to be rocky reefs, rather than sand bars, as was previously thought. This changes previous perceptions of likely mine burial mechanisms off a number of Northwest Shelf ports.

REPORT NUMBER: DSTO-TN-0022; NIPS-97-12242

ACCESSION NUMBER: ADA315399

http://handle.dtic.mil/100.2/ADA315399

Pall, Phillip K. **Thermal Analysis of the Advanced Lightweight Influence Sweep System (ALISS) Superconducting Magnet**. Monterey, CA: Naval Postgraduate School, Monterey, CA: December 1994. 49p.
ABSTRACT: A steady state thermal analysis of the superconducting magnet (SCM) in the Advanced Lightweight Influence Sweep System (ALISS) was performed using commercial Finite Element Modeling (FEM) software. Cryocooler interface temperature from a no-load performance curve and uniform heat flux due to radiation, conduction and instrumentation heat leaks were input as the boundary conditions. Two major cases were examined: one with instrumentation heat flux dispersed around the SCM and one with instrumentation heat flux concentrated. Both resulted in the SCM staying within temperature specifications. A separate group of exploratory cases determined the heat flux values that quenched the SCM, causing cessation of superconductivity. (MM).
ACCESSION NUMBER: ADA293166
http://handle.dtic.mil/100.2/ADA293166

Pittman, Ed P. and J.C. Slone. **A Digital-Analog Magnetic Minesweeping Simulator**. Panama City, FL: U.S. Navy Mine Defense Laboratory. 1963. 66p. Research and Development Report no. 217.

Pope, Dallas L. **Offensive Mine Countermeasures: Enabler for Access and Power Projection**. Newport, RI: Naval War College, Joint Military Operations Dept., 2009. 22p.
Abstract: Consideration of naval mine countermeasures (MCM) often only includes the defensive, reactionary operations which are inherent to the dedicated MCM force. However, given the premium placed on the United States' ability to project power and conduct forcible entry, a more offensive approach must be planned. Joint force commanders rely on the expeditionary nature of naval forces to transport troops and equipment to the fight, support forces ashore, and to establish and maintain local sea control. The US Navy?s ability to conduct this range of operations can serve as a deterrent in itself. The asymmetry of mine warfare allows a relatively weaker enemy to potentially cripple this deterrent effect. Given the adverse effects that defensive MCM can have on the JFCs operational factors of time, space and force, the merits of offensive measures are evident. By eliminating or reducing the mine threat at the source, the commander frees up friendly forces, reduces time delays, and assures freedom of maneuver. Traditional dedicated MCM forces require extensive time to both transit to the area of operations and also to engage in actual counter-mining activities. Additionally, the JFC has to plan for protection of these unarmed forces. Therefore, to reduce the risk of losing the initiative and facing heavier casualties,offensive MCM should be the primary consideration of an operational commander and staff facing a mine threat.
ACCESSION NUMBER: ADA503089
http://handle.dtic.mil/100.2/ADA503089

Poteete, Sam. **Navy's N-Layer Magnetic Model with Application to Naval Magnetic Demining.** Monterey, CA: Naval Postgraduate School, 2010. 104p.
ABSTRACT: From the Sea strategic concept has expanded naval operations from open ocean, blue-water combat environments to the littoral regions in which naval mines can both be an extremely menacing threat to U.S. forces and an effective force multiplier for the Fleet. The Navy/Marine Corps must have efficient Mine Warfare (MIW) forces to ensure the Fleet can carry out operations in the open ocean and littorals, including maintaining open sea lanes of communication and supporting Ship-to-Objective Maneuver Warfare from the Sea while denying

operating areas to the enemy. Every ship has a magnetic signature, which is caused by its iron and steel components. Additionally, the earth's natural magnetic field induces a magnetization in a ship depending on its latitude, longitude, and heading. Exploitation of surface ship and submarine magnetic field signatures by naval influence mines has occurred throughout time. In order to calculate the swept path width for magnetic minesweeping systems currently in use by the U.S. Mine Warfare (MIW) forces, it is necessary to calculate the vector components of the magnetic field strength which are generated by each of several possible system configurations. The Navy's Magnetic Model addresses this needed capability. The Navy's N-Layer Magnetic Model (NLMM) is used to predict the expected performance of magnetic minesweeping equipment in a complex environment consisting of N layers, each with arbitrary conductivity and thickness. The model is used to compute the magnetic field strength produced by various U.S. Navy magnetic minesweeping configurations using a random environmental vertical conductivity structure. To better determine which parameters had the greatest effect on the model and which could be simplified or enhanced, a series of tests were run on actual data sets.

ACCESSION NUMBER: **ADA530636**
http://handle.dtic.mil/100.2/ADA530636
http://edocs.nps.edu/npspubs/scholarly/theses/2010/Sep/10Sep_Poteete.pdf

Potts, Malcolm H. **Don't Forget About Dedicated Sea Mine Countermeasures**. Norfolk, VA: Joint Forces Staff College, 2005. 80p.
ABSTRACT: America's reliance on the seas cannot be overstated. The U.S. depends upon the ocean as both the highway for force deployment and as the medium for global economic security. Free access to the waterways of the world determine the United States' ability to survive and prosper. The threat and the employment of sea mines are capable of interrupting the U.S. quest for national and economic security. Struggling through the Korean Conflict, the U.S. Navy began a slow improvement of MCM forces leading up to the first Gulf War where experiences led to the conclusion that a well equipped dedicated MCM force structure is essential. In the decade which followed, the Navy nurtured a dedicated MCM force that was capable of fully supporting COCOM requirements and combat proven in OIF. Ironically, prior to OIF, the U.S. Navy began to consider a future plan that features the substitution of proven, dedicated MCM forces with technology-leveraged OMCM forces. This move could leave the COCOM/JFC with a vulnerability gap that would be created by the divesting of dedicated forces prior to OMCM platforms being capable of conducting the mission. Specifically, the U.S. Navy s planned organic MCM force has three weaknesses: even with advanced technology the inventory is too small, the reliance on favorable risk and intelligence analysis results is too great, and the heavy reliance on sealift for deployment is not supported by future MCM force structure. To prevent the vulnerability gap and cover the weakness, the U.S. Navy should field a robust dedicated MCM force beyond the currently planned timeline to ensure the successful mission completion of the COCOM/JFC.

ACCESSION NUMBER: ADA436558
http://handle.dtic.mil/100.2/ADA436558

Prenger, F.C., et al. **Heat Pipes for Enhanced Cooldown of Cyrogenic Systems**. Los Alamos National Laboratory, NM, 1996. 11p.
ABSTRACT: In many important cryogenic applications the use of liquid cryogens for system cooling are either not feasible or are unsuitable. In such cases a cryogenic refrigeration system or multi stage cryocooler must be employed to provide the necessary cooling. To shorten cooldown time for such a system, especially if the thermal mass is large, a thermal shunt directly connecting the first stage of the cryocooler to the load during cooldown is desirable. This thermal shunt allows effective utilization of the greater cooling power available from the first stage of the cryocooler early in the cooldown. Upon reaching operating temperature, the thermal shunt must exhibit a high resistance to thermally isolate the first stage of the cryocooler from the load. Heat pipes are well suited to achieve these objectives. The Advanced Lightweight Influence Sweep System (ALISS), under development by the U.S. Navy for shallow water magnetic mine

countermeasures, employs a large, conductively cooled, superconducting magnet that must be cooled from 300 to 4.2 K. Cryogenic heat pipes acting as cryocooler thermal shunts are used to shorten the cooldown time. Ethane, nitrogen and oxygen were evaluated as possible working fluids. A thermal model of the ALISS was developed to evaluate the cooldown performance of various heat pipe combinations. In conjunction with heat pipe performance tests, this model was used to select a suitable design for the heat pipe thermal shunts.
REPORT NUMBER: LA-UR-96-2228, **CONF-9606249-1**
ACCESSION NUMBER: DE96012824
http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=279453

Proceedings of the Ship Control Systems Symposium (7th) Held in Bath, **England on 24-27 September 1981**. Volume 1. Ministry of Defence, Bath (England): 27 September 1984. 115p. [See also Volume 2, **ADA211134**.]
ABSTRACT: Contents: Digital progress in the Royal Navy; US Navy control systems overview; Machinery control initiatives -- A Canadian perspective; Ship automation -- A Dutch view on practice and progress; Digital control and surveillance system for the M-Class frigate of the Royal Netherlands Navy; Propulsion control in the Swedish M80 Class Mine Countermeasures Ships; Practical experience in the application of microprocessors to machinery control and surveillance; Multivariable adaptive control of ships motions; A classical approach to a microprocessor based PID Autopilot design; Model tests and full-scale trials with a rudder-roll stabilisation system.
ACCESSION NUMBER: ADA211133

Proceedings of the Third International Technology and Mine Problem Symposium, **6-9 April 1998**, **Naval Postgraduate School**, **Monterey**, **California**. Monterey, CA: Naval Postgraduate School, June 1999.
*ABSTRACT: The Mine Problem is captured in this symposium using a metaphor of the following 5 pillars: 1**)** Mine Design and Technology - The Problem of World-wide Proliferation; 2) Naval Mine Warfare - Offensive and Defensive; 3) Land Mine Warfare - Offensive and Defensive; 4) Humanitarian and Peacekeeping Demining; and 5) Emergent Technology. The international reversion to the scourge of the dumb' anti- personnel land mines has raised public awareness of mines. Less well known, but no less potentially significant, is the residue of naval mines and ordnance that exists in areas of great economic importance. The psychological threat of mines and unexploded ordnance far surpasses the actual lethal potential. We cannot assume that mines laid in World War II or earlier have become inert.*
ACCESSION NUMBER: ADM001009 [CD-ROM]
DKL V 856 .T42 1998 GENERAL

Queen, Carmen G. **Four Quadrant Open Water Characteristics of Controllable Pitch Propeller 4837 Designed for MCM (Model 5401).** Bethesda, MD: David W. Taylor Naval Ship Research and Development Center, Ship Performance Department, October 1981. 58p.
ABSTRACT: An experimental program was conducted at the David W. Taylor Naval Ship Research and Development Center (DTNSRDC) to predict the open water thrust and torque of the MCM design propeller over the four quadrants of operation. The analysis revealed no unusual results with regard to performance.
REPORT NUMBER: DTNSRDC/SPD-0983-04
ACCESSION NUMBER: ADA105316

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 2. Study Review Summaries. Part I**. Final report. 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 485p.

ABSTRACT: Contents: Airborne ASW; Airborne AAW; Airborne attack; Environmental systems; Mining; Mine countermeasures; Ocean surveillance; Submarine ASW; Submarine attack; Surface ASW.

ACCESSION NUMBER: AD0912444

http://www.dtic.mil/dtic/tr/fulltext/u2/912444.pdf

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 3. Study Review Summaries. Part II**. Newport Beach, CA: Ultrasystems Inc., 31 October 1972. 469p.

ABSTRACT: Contents: Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; Undersea surveillance; Amphibious assault; Reconnaissance/intelligence; Logistics; Special warfare; Airborne ASW and submarine ASW; airborne asw and surface asw; airborne asw and undersea surveillance; airborne aaw and airborne attack; airborne attack and surface aaw; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mining and mine countermeasures; mine countermeasures and navigation; Ocean surveillance and electronic warfare; Submarine asw and surface asw; submarine asw and surface asw; Submarine attack and surface asw; surface asw and surface attack; surface aaw and surface attack; Surface aaw and electronic warfare; logistics and ship support; Airborne AAW, surface aaw and electronic warfare; airborne attack, surface attack and amphibious assault; airborne attack, surface attack and special warfare; Submarine ASW, submarine attack and surface ASW; airborne asw, submarine asw, submarine attack and sea based strategic systems; submarine asw, submarine attack, surface asw and surface attack; and airborne asw, ocean surveillance, submarine asw, surface asw and undersea surveillance.

ACCESSION NUMBER: AD0912445

Rau, John G. and Russel J. Egbert. **A Study of Measures of Effectiveness Used in Naval Analysis Studies. Volume 4. MOE Reviews**. Final report 1 March 1971-31 October 1972. Newport Beach, CA: Ultrasystems, Inc., October 1972. 226p.

ABSTRACT: Contents: Airborne ASW; airborne attack; Mining; Mine countermeasures; Ocean surveillance; submarine ASW; Surface ASW; Surface ASW; Surface AAW; Surface attack; Sea based strategic systems; Electronic warfare; undersea surveillance; Amphibious assault; Naval communications; Command and control; Reconnaissance/ intelligence; airborne ASW and surface ASW; airborne AAW and airborne attack; airborne attack and surface attack; airborne attack and reconnaissance/intelligence; Mine countermeasures and amphibious assault; submarine ASW and command and control; submarine attack and surface ASW; submarine attack and surface attack; surface ASW and surface attack; surface AAW and surface attack; surface AAW and command and control; surface attack and amphibious assault; electronic warfare and naval communications; Logistics and ship support; airborne ASW, ocean surveillance and surface ASW; airborne ASW, submarine ASW and submarine attack; airborne AAW, airborne attack and surface AAW; mine countermeasures, command and control and navigation; airborne ASW, airborne AAW, surface ASW and surface AAW; airborne ASW, mining, submarine ASW, submarine attack, surface ASW, logistics and ship support; and airborne AAW, airborne attack, electronic warfare, naval communications, command and control, reconnaissance/ intelligence, logistics and special warfare.

ACCESSION NUMBER: AD0912446

http://handle.dtic.mil/100.2/AD912446

Ray, Gregory P. **Bomb Strike Experiment for Mine Clearance Operations.** Monterey, CA: Naval Postgraduate School, 2006. 212p.
ABSTRACT: The Bomb Strike Experiment for Mine Countermeasure Operations, currently sponsored through the Office of Naval Research mine impact burial prediction project, is part of a multi-year, comprehensive effort aimed at enhancing the Navy's fleet naval mine clearance capability and success. The investigation discussed in this paper examines the experimental and theoretical characteristics of a rigid body falling through the air, water, and sediment column at high speed. Several experiments were conducted to launch bomb-like rigid bodies with the density ratio similar to operational munitions, namely the MK-84 general purpose bomb, into a hydrodynamic test tank. Careful observations of the bomb-like rigid body's position and orientation were collected and analyzed to produce a series of three-dimensional coordinate time-space data tables and plots. The resulting data set reveals a strong correlation between shape type and trajectory and dispersion patterns for rigid bodies moving through the water column at high velocity. This data will be used for numerical verification of the initial three- dimensional model (STRIKE35) aimed at predicting the overall trajectory, maneuvering, burial depth and orientation of a falling high-velocity rigid body in the air-water-sediment column. The long-term goal of this project is to improve warhead lethality for use in quick, precise and accurate strikes on known enemy naval minefields in the littoral combat environment.
ACCESSION NUMBER: ADA445556
http://handle.dtic.mil/100.2/ADA445556
http://edocs.nps.edu/npspubs/scholarly/theses/06Mar%5FRay.pdf

Reed, Donald E., et al. **Acquisition of Mine Countermeasures Ships**. Washington, DC: Department of Defense, Office of the Inspector General, 15 June 1992. 39p.
ABSTRACT: In March 1980, the Chief of Naval Operations issued a decision to build a wooden-hulled Mine Countermeasures (MCM) ship based on the existing Minesweeper, Ocean 523 design. The MCM class ships will clear bottom and moored mines in coastal and offshore areas. In FY 1983, the MCM ship program was approved for 14 ships at an estimated cost of $1.3 billion. By FY 1991, as a result of contract modifications and inflation, the program had grown to $1.7 billion. The MCM ship program is managed by the Program Manager Ship 303 at the Naval Sea Systems Command. The audit's overall objective was to evaluate the acquisition management of the MCM ship program to determine whether the MCM ships were effective, properly supported, and economically procured. The audit also included a review of applicable internal controls.
REPORT NUMBER: IG/DOD-92-102
ACCESSION NUMBER: ADA377718
http://handle.dtic.mil/100.2/ADA377718
http://www.dodig.osd.mil/audit2/92-102.pdf

Rios, John J. **Naval Mines in the 21st Century: Can NATO Navies Meet the Challenge?** Monterey, CA: Naval Postgraduate School, 2005. 61p.
ABSTRACT: With the end of the Cold War, NATO countries have embarked on transformation initiatives within their militaries to address the new security realities of the 21st century. One of the realities that has not changed is the threat posed to modern navies by sea mines. Global proliferation of sea mines, both older variants and advanced designs, has continued to grow and presents a unique challenge to maritime security for NATO. As NATO forces engage in more expeditionary operations, they must be prepared to counter the danger posed by mines from state and non-state actors. This includes ensuring that vital sea lines of communication (SLOCS), strategic chokepoints throughout the world, commercial ports and naval bases remain open and uncontested. In order to meet the challenge of the 21st century mine threat, NATO must continue to develop balanced MCM capabilities that satisfy expeditionary requirements (such as OMCM for

in-stride operations) while maintaining effective dedicated forces to conduct sustained MCM operations against more traditional mining operations.
ACCESSION NUMBER: ADA435603
http://edocs.nps.edu/npspubs/scholarly/theses/05Jun%5FRios.pdf
http://handle.dtic.mil/100.2/ADA435603

Roberts, D.W. **Recovery Hook Assembly**. Washington, DC: Department of the Navy. Patent filed 4 December 1972, patented 29 January 1974. 7p.
ABSTRACT: The invention pertains to recovery devices, and, in particular, it is a unique hook assembly for engaging, hooking, and picking up a wire, cable, rope, or the like. In even greater particularity, the subject invention is a self-guided marine mine countermeasure retrieval hook assembly system which will effect its own maneuvering forces and apply them to the wire, line, cable, etc., to which it is connected when towed thereby through water, sea water, and other fluid mediums.
REPORT NUMBER: PATENT: 3,788,262
http://www.uspto.gov/patft/

Romberger, David D. **Optimization Methods for Mixed Minefield Clearance**. Master's thesis. Monterey, CA: Naval Postgraduate School, September 1996. 84p.
ABSTRACT: This thesis describes the development and implementation of an improved optimization feature for the minefield clearance TDA MIXER. A constrained form of MIXER's original local optimal search method is proposed, followed by an exhaustive search method, and then a simulated annealing method. Computational efficiency and program run times are examined for the exhaustive search method. Also, a performance comparison of "optimal" solutions for the local search and simulated annealing methods is given. A final version of the optimization feature incorporates all threesearch methods.
ACCESSION NUMBER: ADA319531
http://handle.dtic.mil/100.2/ADA319531

Rossi, Gary. L. **Explosive Ordnance Disposal (EOD) Mine Countermeasure (MCM) Tactics Development Plan**. Master's thesis. Redlands, CA: University of Redlands, 1994.
ABSTRACT: Presently, Explosive Ordnance Disposal (EOD) Mine Countermeasures (MCM) detachments are only proficient in two types of diving area searches. During Desert Shield and Desert Storm, EOD MCM detachments were tasked to conduct larger area searches, requiring the expertise in a variety of clearance diving techniques. After Desert Storm, EOD MCM detachments started training in the various clearance diving techniques depicted in the Allied Tactical Publications (ATPs). However, the search rates and probabilities of detection of the clearance diving techniques were and still not supported by data. Therefore, our current EOD MCM Detachment officers-in-charge and senior enlisted EOD technicians are not provided with data based information which is necessary in providing valid recommendations to the Commander, Carrier Battle Group or Commander, Amphibious Ready Group in a situation such as Desert Shield or Desert Storm.

Sanders, Mark E. **Amphibious Operations in a Mine Environment: A Clear Path to the Beach…Unmarked**. Maxwell AFB, AL: Air Command and Staff College, 2000. 27p.
Abstract: *The intended audience for this paper is those individuals with a working knowledge of naval concepts in littoral regions, specifically with reference to amphibious operations in a mine*

environment. As such, liberty is taken to not fully explain all mine warfare and amphibious terms and concepts referred to within. Basic mine warfare concepts of employment and capabilities are assumed to be within the common knowledge of the reader. Department of the Navy officers, acquisition professionals, government research and laboratory personnel, and defense contractors involved in solving the Navy-Marine Corps challenges in achieving the full intent of Operational Maneuver From the Sea are encouraged to discuss the contents and concepts in this paper. The intent of this paper is to explain the problem in marking clear access areas to littoral penetration points in the conduct of amphibious operations in a mine environment and recommend concepts of operations to address existing shortfalls in tactics and equipment. The research methodology used was a combination of MCM operational experience of the author with traditional professional journal and historical documentation research. The findings of this paper should raise the level of understanding concerning the criticality of the current shortfall in lane marking capabilities as it affects operational maneuver doctrine. Recommendations will be presented as the first step in achieving a solution to marking clear access through mined waters to littoral penetration points.

ACCESSION NUMBER: ADA394987

http://handle.dtic.mil/100.2/ADA394987

https://research.maxwell.af.mil/viewabstract.aspx?id=2315

Scarzello, John F., Peter B. Keller, and Richard W. Harrison. **Mine Sweeping System for Magnetic and Non-Magnetic Mines**. Washington, DC: Department of the Navy. Patent filed 29 December 1994, patented 28 January 1997. 15p.

ABSTRACT: A mine sweeping system including deployable horizontal antennas to establish a detection and navigation grid extending underwater from a beach to a distance offshore. A computer-controlled transmitter unit having a waveform generator and amplifier, transmits signals to each antenna, at unique frequencies and phases for different spatial locations within the grid. An autonomous underwater vehicle having multi-integrated sensors detects anomalies in the electromagnetic field caused by both magnetic and non-magnetic objects therein during underwater travel utilizing the electromagnetic field as a navigational grid. The autonomous underwater vehicle also deposits mine clearing explosives at each magnetic anomaly for detonation under command signal using the horizontal antennas which provide a means for establishing a navigation grid to permit landing craft and other vessels to navigate in the region cleared of mines.

REPORT NUMBER: PATENT: 5,598,152

http://www.uspto.gov/patft/

Schroeder, Erwin A. and Geoffrey Green. **Finite Element Shock Analysis of a Cryogenic Refrigerator**. Interim report January-August 1993. Bethesda, MD: Naval Surface Warfare Center Carderock Division, Ship Systems and Programs Directorate: December 1994. 30p.

ABSTRACT: Two-stage Gifford-McMahon refrigerators are candidates for use in cooling superconducting magnets for naval applications in mine countermeasures and electric-drive propulsion for ships. For these applications, the refrigerators can be expected to undergo shock and vibration due to the motion of the platform on which they are mounted and to explosions of nearby mines. If the refrigerator is to continue operating effectively, the cylinder walls must not be permanently deformed when subjected to shock loads, and therefore stresses in the walls must not approach the elastic limit of the wall material. The stress in the cylinder walls due to specified shocks was determined by an axisymetric finite element shock analyses of the two-stage cylinder and displacer assembly. For this analysis, it was assumed that the displacers were at the bottom of their stroke and each was resting on the bottom of its cylinder. Constant horizontal and vertical accelerations of 100 g and a time-dependent acceleration with maximum amplitude of 103 g were applied to the model The analysis for the vertical shock loading produced a maximum stress of 36.7 MPa, 5 percent of yield for the 304-type stainless steel used for the cylinder walls.

ACCESSION NUMBER: ADA294278
http://handle.dtic.mil/100.2/ADA294278

Schulz, D. A. **Shallow-Water Mine Countermeasure Capability for USMC Ground Reconnaissance Assets**. Quantico, VA: Marine Corps War College, 2004p. 11p.
Abstract: As the Marine Corps looks to the future with its concept of expeditionary maneuver warfare (EMW), shallow-water mines remain a "show-stopper" to the Corps' forcible entry requirement. With limited Naval assets available, MAGTF commanders are still dependent on Marine ground reconnaissance assets for amphibious reconnaissance of potential beach landing sites -- to include the detection of shallow-water mines. However, while the shallow-water mine threat has grown exponentially in number and complexity since World War II, the Marine Corps' mine countermeasure (MCM) capability has not. In fact, reconnaissance Marines are no longer trained or equipped to detect, mark, or clear shallow water mines. At a minimum, this requires training in shallow-water mine detection, to include hand-held sonar, and specialized nonmagnetic dive equipment. This would allow Marines to conduct amphibious reconnaissance in potentially mined areas, determine if a mine threat exists, and look for gaps in the enemy's shallow-water defenses. Time and resources permitting, advanced MCM training could be added to give reconnaissance Marines a limited capability to detonate and clear shallow-water mines and other obstacles. Marine Corps ground reconnaissance assets must develop a shallow-water mine countermeasure capability to support the forcible entry requirement of expeditionary maneuver warfare.
ACCESSION NUMBER: ADA520516
http://handle.dtic.mil/100.2/ADA520516

Semi-annual Project Review of the Experimental Diving Unit, **November 1993 to April 1994**. Interim research report no. DCIEM no. 94-30. Downsview (Ontario): Defence and Civil Institute of Environmental Medicine, c1994. 47p.
ABSTRACT: Description of 12 projects of the Experimental Diving Unit conducted from November 1993 to April 1994. Major projects include the development of a freeze-proof regulator, and decompression tables for the Canadian Underwater Mine-countermeasures Apparatus. For each project, information is given on defence relevance, description of the project, progress, and projections. A task description sheet is also included for each.
ACCESSION NUMBER: MIC-94-0726

Shives, T.R. and S.R Low. **Tensile Tests of Type 305 Stainless Steel Mine Sweeping Wire Rope**. Gaithersburg, MD: National Institute of Standards and Technology (IMSE), Metallurgy Division, October 1989. 29p.
ABSTRACT: The Naval Coastal Systems Center submitted to the National Institute of Standards and Technology (NIST) approximately 360 feet of each of two different AISI 305 stainless steel wire ropes for testing. Both wire ropes were nominally 5/8 inch in diameter. One was stated as having a 6 x 19 configuration and the other a 7 x 7 configuration. The first number in such a designation indicates the number of strands in the wire rope and the second number indicates how many wires there are per strand. For example, the wire rope with a 6 x 19 configuration consists of six strands of 19 wires each. As shown later, the wire rope stated to have a 7 x 7 configuration actually had a 6 x 7 configuration with an independent wire rope core (IWRC). The core is one of the three basic parts of a wire rope. The other two are the wires and the strands. The core may be comprised of steel or fiber. In the case of both of the submitted wire rope samples, the core consisted of an independent wire rope.
REPORT NUMBER: NISTIR-89-4174
ACCSSION NUMBER: PB90130287

Simmons, Anthony L. **Discrete Digital Filter for Forward Prediction of Seaway Elevation Response.** Monterey, CA: Naval Postgraduate School, March 1997. 83p.

ABSTRACT: The Autonomous Underwater Vehicle (AUV) must be able to operate in various shallow water sea state conditions. In order to have a precise navigation and steering system, and efficiently place charges on underwater mines, the AUV must be able to sense and overcome hydrodynamic forces which are caused by waves. This thesis establishes a model of sea state conditions based on spectral analysis, and uses the model to predict future knowledge of the sea. This prediction is determined by the random white noise output of a discrete, digital filter. The development of the discrete, digital filter is described herein. The Pierson-Moskowitz (P-M) spectrum which models seaway elevations using linear wave theory is used as a target spectrum which the filter will track. Cross-correlation between the P-M target spectrum and digital filter have shown that a reasonably accurate estimate of wave elevations can be predicted one full wave period into the future.

ACCESSION NUMBER: ADA331882

http://handle.dtic.mil/100.2/ADA331882

http://edocs.nps.edu/npspubs/scholarly/theses/97Mar_Simmons.pdf

Spangler, Peter K. **Hydrodynamic Design and Evaluation of a Size 5 Reinforced-Plastic Minesweeping Float**. Washington, DC: David Taylor Model Basin, April 1960. 23p.

ABSTRACT: An 0 Type, Size 5, Reinforced-plastic Minesweeping Float was designed and fabricated at the David Taylor Model Basin. Tests were conducted in the circulating-water channel to determine the net buoyancy, lift, drag, and towing characteristics. Tests to verify towing characteristics were also made using a small boat in the Chesapeake Bay. After modifications to towpoint and control surfaces, the float towed in a stable manner over the speed range of 0 to 7 knots. It is concluded that a Size 5 Minesweeping Float fabricated from plastic will have satisfactory towing characteristics and will allow a substantial reduction in the handling weight.

REPORT NUMBER: DTMB-1422

ACCESSION NUMBER: AD0650636

http://handle.dtic.mil/100.2/AD650636

Sparks, Michael E. **A Critical Vulnerability**, **A Valid Threat. U.S. Ports and Terrorist Mining.** Norfolk, VA: Joint Forces Staff College, 2005 68p.

ABSTRACT: Sea mines have been a nuisance in the maritime domain since their debut during the Revolutionary War to their most recent use in Operation Iraqi Freedom. An indiscriminate weapon, mines inflict fear and uncertainty in maritime powers and can successfully deny an adversary access to the high seas. It is the effects produced from the employment of mines which make them attractive to the terrorist. Fear, uncertainty, insecurity and the removal of freedom, all make mines a weapon of choice for the terrorist. For these reasons, it is worthy of assessing our capability to protect and defend against this specialized threat. This paper will outline the economic and strategic significance of the U.S. Maritime Transportation System (MTS) and identify the shortfalls in current capabilities to defend the MTS from terrorist mining. The effectiveness of mines to deny access and achieve strategic goals will be presented using historical examples. More recently, indications that Osama bin Laden has acquired the capability to use mines, and that he has the desire to target our economy will be provided to support the urgency and the significance of the threat. The mission of mine countermeasures will be addressed as a contributor to the overall problem due to the difficulty of the mission. This will be reinforced by a general comparison of the recent mine countermeasures effort in Iraq to the suspected level of effort required to clear a U.S. port of mines. This comparison will demonstrate

how the lack of a mine countermeasures capability by the Coast Guard to deter the employment of, or, when deterrence fails, to clear mines from harbors coupled with the consolidation of Navy assets in one port, thereby increasing response time, are the primary factors which dramatically increase the economic and strategic impact of a terrorist mining incident.
ACCESSION NUMBER: ADA436598
http://handle.dtic.mil/100.2/ADA436598

Spieker, H. **Mine Countermeasures.** Naval Intelligence Support Center, Washington, DC. Translation Division: 25 April 1983. 13p. [Trans. of **Soldat und Technik**, D 6323 E (Germany, F.R.) v. 2, p. 72-78, February 1983.]
ABSTRACT: None available.
ACCESSION NUMBER: ADA129354

Spies, R. **Development of a Device for Pressure Mine Sweeping**. Final report. May-August 1956. Azusa CA: Aerojet-General Corporation, January 1957. 11p.
ABSTRACT: None Available.
ACCESSION NUMBER: AD0129404

Stabnow, R. J. and K. E. Dornstreich. **Degaussing Magnetic Ranging Systems**. Annual Task Report for Fiscal year 1967. White Oak, MD: Naval Ordnance Laboratory, July 1967. 19p.
ABSTRACT: This report presents factors that are considered to influence the development of modern degaussing magnetic ranging systems that would satisfy the current and projected requirements for measuring the Magnetic fields of all naval vessels.
ACCESSION NUMBER: AD0819184

Stabnow, R.J. and K.E. Dornstreich. **Degaussing Magnetic Ranging Systems**. White Oak, MD: Naval Ordnance Laboratory, 28 July 1967. 19p.
ABSTRACT: This report presents factors that are considered to influence the development of modern degaussing magnetic ranging systems that would satisfy the current and projected requirements for measuring the Magnetic fields of all naval vessels.
REPORT NUMBER: NOLTR-67-129
ACCESSION NUMBER: AD0819184

Suez Canal Clearance Operation, **Task Force 65**. Norfolk, VA: Task Force 65, May 1975. 113p.
ABSTRACT: This report provides the documentation of the Suez Canal Clearance Operations NIMBUS STAR, NIMBUS MOON, and NIMROD SPAR undertaken by Task Force 65 during the period 11 April to 15 December 1974. Under the terms of two bilateral agreements between the Government of Egypt and the U.S. Government, U.S. Forces were employed to sweep the Suez Canal of influence mines (Operation NIMBUS STAR), advise and assist in clearance of unexploded ordnance from the Canal and adjacent land areas (Operation NIMBUS MOON), and remove ten designated wrecks from the Canal (Operation NIMROD SPAR). The report discusses mission background, operational accomplishments, logistical support, technical methods and equipments, environmental factors and provides conclusions and lessons learned.
ACCESSION NUMBER: ADA010261
http://handle.dtic.mil/100.2/ADA010261

Swimbanks, Malcolm A, Christopher E. Ruckman, John M. Holford . **Dynamic Degaussing System**. Patent. Alexandria, VA: VSSL Commercial, Inc., Swptember 2006. 23p.

ABSTRACT: A dynamic degaussing system includes a magnetic field sensor for generating a sensor signal in response to a sensed magnetic field. The magnetic sensor is coupled to a controller that produces an output signal based on the sensor signal. The controller may include feedforward and feedback control loops. The output signal of the controller controls a magnetic field generator which generates a magnetic field so as to attenuate the sensed magnetic field. According to one aspect of the invention, a vessel is provided with a reduced magnetic signature and a control system for controlling magnetic fields about a podded electric motor. The control system employs feed-forward and feedback control in tandem. The control system may be dynamically adapted to changing physical characteristics of the motor. Control signals are generated in response to sensed or predicted magnetic fields internal to, or external to, the motor. The control inputs may be used to modify one or more motor driving currents, or to drive one or more magnetic field generators, so as to attenuate one or more magnetic field components generated by the motor.

REPORT NUMBER: PATENT: 7,113, 384

http://www.uspto.gov/patft/

Taber, Victoria L. **Environmental Sensitivity Study on Mine Impact Burial Prediction Model**. Master's thesis. Monterey, CA: Naval Postgraduate School, March 1999. 50p.

ABSTRACT: The Navy's Impact Burial Prediction Model creates a two dimensional time history of a bottom mine as it falls through air, water, and sediment. The output of the model is the predicted burial depth of the mine in the sediment in meters, as well as height, area and volume protruding. Model input consists of environmental parameters and mine characteristics, as well as parameters describing the mine's release. The model user seldom knows many of these parameters, and those that are known may be of questionable precision. In order to determine which parameters had the greatest effect on the model and which could be simplified or eliminated, a series of sensitivity tests were performed. It was found that the model data ingest could be greatly simplified without sacrificing accuracy too much. However, several parameters including sediment shear strength were found to have a large effect on the model and were investigated flirter.

ACCESSION NUMBER: ADA361822

http://handle.dtic.mil/100.2/ADA361822

http://edocs.nps.edu/npspubs/scholarly/theses/99Mar_Taber.pdf

Tan, Yong C. **Synthesis of a Controller for Swarming Robots Performing Underwater Mine Countermeasures.** Annapolis, MD: Naval Academy, 2004. 111p.

ABSTRACT: This Trident Scholar project involved the synthesis of a swarm controller that is suitable for controlling movements of a group of autonomous robots performing underwater mine countermeasures (UMCM). The main objective of this research project was to combine behavior-based robot control methods with systems-theoretic swarm control techniques to achieve a hybrid that has the best characteristics of both. The sub-goals were: a) To simulate and study a simplified version of the UMCM problem, in 2D with basic robot dynamics and behaviors. b) To investigate the performance of both behavior-based and systems-theoretic controllers for UMCM, and to determine their advantages and disadvantages. Careful development of behavior-based methods using a non-traditional differential equations approach facilitated the hybridization of the two controllers under study, giving rise to a more functional controller capable of controlling swarm level functions while executing the appropriate behaviors at the same time.

ACCESSION NUMBER: ADA24661

http://handle.dtic.mil/100.2/ADA424661

Toh, Eng Yee. **Effectiveness of a Mine-Avoidance Sensor on Minefield Transit.** Monterey, CA: Naval Postgraduate School, 2005. 81p.

ABSTRACT: Simulation is used to study the effectiveness of mine avoidance sonar (MAS) use on safe minefield transit by a ship. A MAS is able to detect mine-like objects but currently cannot classify the detected object as a mine or a non-mine mine-like bottom object (nombo). The tactic is to avoid all detected objects. The minefield is represented by a finite grid of fixed width and length. The representation of ship maneuvering in the simulation is similar to that of a wall tracing algorithm for a computer mouse going through a maze. The simulation results indicate that the use of the mine avoidance sonars can increase the probability of successful transit. The probability of successful transit increases as the probability of detection increases for minefield object densities less than 50% of the field. However, the probability of successful transit is sensitive to the mine and NOMBO (NOn-mine Mine-like Bottom Object) density. The probability of successful transit can be increased if the density of mine-like objects is decreased. Some suggestions on mine avoidance tactics are made from the results obtained to show the limitations and effectiveness of the MAS with regards to the open waters, narrow channels, ports and harbors.

ACCESSION NUMBER: ADA432329

http://handle.dtic.mil/100.2/ADA432329

http://edocs.nps.edu/npspubs/scholarly/theses/05Mar%5FToh.pdf

Trenchard, Michael E., et al. **Two-Part Study on the Use of Bathymetric and Nautical Mapping Information in a Moving Map Display to Support Mine Counter Measures Operations**. Stennis Space Center, MS: Naval Research Laboratory Detachment, 21 August 2000. 9p.

ABSTRACT: Cockpit moving map displays have been employed in the tactical air community for several years to support air-to-air and air-to-ground missions and have been shown to be excellent situational awareness (SA) tools. This study examines the potential of using the next-generation cockpit moving map display to support the difficult Mine Counter Measures (MCM) and Mine Sweeping Operations. Specifically, the Naval Research Laboratory - Stennis Space Center (NRLSSC) will leverage the Naval Air Systems Command's Tactical Aircraft Moving Map Capability (TAMMAC) digital moving map system as a demonstration platform to incorporate bathymetric and nautical map data designed to support in-flight MCM operations. Of critical importance to this project is a two-part human factors study to: (1) determine MCM helicopter aircrew preferences from the various types of map data under consideration, and (2) measure and evaluate aircrew performance both with and without the moving map capability. This study is being conducted as part of NRLSSC's Generation and Exploitation of Common Environment (GECE) project that will Support MCM and amphibious operations in Fleet Battle Experiment - India (FBE-I) or Kernal Blitz 2001 (KB 01).

REPORT NUMBER: NRL/PP/7440--00-0013

ACCESSION NUMBER: ADA385583

http://handle.dtic.mil/100.2/ADA385583

U.S. Department of Defense. Inspector General. **Acquisition of the Navy Rapid Airborne Mine Clearance System**. Washington, DC: Office of the Inspector General, 2007.

ABSTRACT: RAMICS is a non-towed airborne mine neutralization system. The system will operate from an MH 60S Organic Airborne Mine Countermeasures Helicopter deployed from the Littoral Combat Ship in the Carrier Strike and Expeditionary Strike Groups. When fielded, RAMICS will provide the Navy with rapid-response, surface and near-surface mine reacquisition

and neutralization capabilities. The Program Manager, Mine Warfare is developing RAMICS in preparation for the low-rate initial production decision that is planned for August 2008. The Naval Surface Warfare Center, Panama City, Florida, is providing technical direction support to the Program Manager, Mine Warfare by developing capability requirements for RAMICS and monitoring the work of several subcontractors developing the system. The milestone decision authority for the program is the Navy Acquisition Executive. As of December 2006, the program's funding to develop and procure the system totaled $327.0 million, with $127.3 million in research, development, test, and evaluation funds and $199.7 million in procurement funds.

REPORT NUMBER: D-2007-084

http://www.dodig.mil/Audit/reports/FY07/07-084.pdf

van der Weiden, A. M. **RTPI Prototype.** Final report. The Hague, (Netherlands): Physics Laboratory, RVO-TNO, September 1997, 28p.

ABSTRACT: The Real Time Performance Indicator (RTPI) prototype system assesses the quality of mine detection using a sonar. The system is designed for the Alkmaar class mine hunters equipped with dedicated instrumentation for measurement of the sound velocity profile, the absorption and reverberation in the vicinity of the hunter at the time of the operation (hence real time). The quality of mine detection is expressed as a detection probability curve which indicated the detection probability as a function of the athwart distance and as A and B values which indicate the characteristic detection width and the characteristic detection probability. The system is enclosed in the OPPAS rack and uses many of the OPPAS system interfaces. RTPI incorporates the HUNTOP simulator which simulates a mine hunting operation (detection phase) using real world environment data and computes the desired probabilities.

REPORT NUMBER: FEL-97-A219

ACCESSION NUMBER: ADA332165

http://handle.dtic.mil/100.2/ADA332165

Weber, Timothy R. **An Analysis of Lemmings: A Swarming Approach to Mine Countermeasures in the VSW/SZ/BZ**. Monterey, CA: Naval Postgraduate School, December 1995. 103p.

ABSTRACT: Lemmings are autonomous tracked underwater vehicles which utilize a swarming approach to mine detection and neutralization in the very shallow water, surf and beach zones (VSW/SZ/BZ). The Navy and the Marine Corps are in great need of developing an effective 'in stride' clearance/breaching method to further enhance the effectiveness and viability of their littoral warfare skills. The Lemmings system has the potential to fulfill this critical need in a cost effective, reliable manner. Utilizing the Janus interactive wargaming simulation, an amphibious operation was modeled, with the amphibious landing taking place through a minefield in the littoral zones. Three scenarios of this model were developed: an amphibious landing through a minefield utilizing no clearing/breaching assets; an amphibious landing through a minefield utilizing current clearing/breaching assets; and an amphibious landing through a minefield utilizing Lemming swarms as the clearing/breaching assets. A comparative analysis of these three scenarios will be performed, examining the measures of effectiveness of landing vehicles killed/damaged, combat power ashore at a given time, MCM assets killed, and percentage of ***mines neutralized.***

ACCESSION NUMBER: ADA307437

http://edocs.nps.edu/npspubs/scholarly/theses/95Dec_Weber.pdf
http://handle.dtic.mil/100.2/ADA307437

Weber, Timothy R., Brad Mansager, and Carlos F. Borges. **High Resolution Modeling of Naval Mine Countermeasures**. Monterey, CA: Naval Postgraduate School, September 1996. 45p.
ABSTRACT: This report examines a modeling approach for naval mine countermeasures (MCM) in the very shallow water (VSW) surf zone (SZ) and beach zone (BZ). Clearing mines in this region of the battlefield poses serious problems to an amphibious landing force. Using an accredited U.S. Army model (Janus), modifications were made to the database creating amphibious systems and threat minefields. Three scenarios were developed representing an amphibious landing of a battalion-sized force using (1) no clearing; (2) traditional (current) MCM; and (3) a new technology (Lemmings). Data was collected from each scenario to investigate the ability of Janus to represent naval MCM at the battalion landing team level of interest.
REPORT NUMBER: NPS-MA-96-004
ACCESSION NUMBER: ADA319359
http://handle.dtic.mil/100.2/ADA319359
http://edocs.nps.edu/npspubs/scholarly/theses/NPS-MA-96-004.pdf

Weidemann, A., et al. **Ocean Color Satellite Derived Products in Support of Diver and Special Forces Operations During OPERATION IRAQI FREEDOM.** Stennis Space Center, MS: Naval Research Laboratory, 2004. 12p.
ABSTRACT: As missions for Explosive Ordinance Disposal (EOD) units and Special Operations Forces (SOF) move closer into coastal and even "riverine" areas, there is an increased requirement for information on water clarity. This water clarity is important from the standpoint of detecting mines and minelike objects (MLO) on the bottom, in the water column, or attached to the hull of a vessel. It is also important for insersion of an EOD or SOF divers into harbors and hostile areas undetected for demining operations. In addition, as missions move at a more demanding pace, environmental intelligence is critical in determining when and where operations are most likely to be successfull. Environmental information is now demanded on the order of minutes to hours and not days to weeks. The reality of dealing with variable environmental conditions was no where more apparent than during OPERATION IRAQI FREEDOM (OIF). During OIF there were several missions that relied on the timely delivery of water clarity information. Here we present how ocean color imagery was utilized to support EOD and SOF operations during OIF and how algorithms developed within one week were used for active operations. We also show the integration of current data into the products that allowed the warfighter to evaluate several key environmental factors.
ACCESSION NUMBER: ADA430177
http://handle.dtic.mil/100.2/ADA430177

Weller, Royal and Harry S. Jones. **Mine Sweeping Means**. Patent. Washington, DC: Department of the Navy, February 1980. 8p.
ABSTRACT: In a mechanism for sweeping a pressure controlled mine arranged within a body of water comprising a plurality of water entraining devices, each of said devices comprising a pair of pressure plates, a plurality of bracing members for maintaining the pressure plates of each pair in predetermined fixed space relation with respect to each other, a plurality of flexible tension members interconnecting said pairs of pressure plates whereby the plates are adapted to cause the water entrained between said plates to be moved sufficiently to reduce the pressure of the water adjacent the mine to a predetermined value as the mechanism travels over the mine, and means of causing movement of said mechanism above the mine.
REPORT NUMBER: PATENT: 4,188,905
http://www.uspto.gov/patft/

Wenzel, Mary L. **Identification of Weather Deck Runoff Discharge Constituents Onboard a U.S. Navy Mine Countermeasure (MCM-1) Class Ship**. Bethesda, MD: Naval Surface Warfare Center Carderock Division, Survivability Structures and Materials Directorate, February 2000. 70p.
ABSTRACT: At the request of Naval Sea Systems Command (NAVSEA 05L13), representatives from Carderock Division, Naval Surface Warfare Center, Puget Sound Naval Shipyard, and M. Rosenblatt & Son, Inc., conducted a shipboard assessment aboard a U.S. Navy MCM-1 class ship to identify constituents that have the potential to contribute to weather deck runoff. The data obtained during the assessment will be used to develop the MPCD for weather deck runoff. The shipboard assessment team conducted a one day at-sea and a one day in-port assessment aboard two different MCM-1 class ships to observe and document topside equipment and processes, general housekeeping practices and their associated materials. In addition, the team solicited crew feedback regarding methods to reduce or eliminate discharge constituents and identified potential MPCDs. As a result of the information obtained and the observations made during the assessment, the following constituents were identified as having the potential to contribute to weather deck runoff (in order of predominance): MIL- G-24139, approximately three pounds are used to lubricate the swivel fittings on the booms that raise and lower the mine neutralization system remotely operated vehicle and approximately one-half pound is used to lubricate the drive gear located on the acoustic cable reels; motor gasoline which may be spilled when refueling the RHIBs onboard ship; and Simple Green detergent used to clean the weather decks and topside equipment.
REPORT NUMBER: NSWCCD-63-TR-2000/53
ACCESSION NUMBER: ADA380283
http://handle.dtic.mil/100.2/ADA380283

White, Kenneth George and Daniel Conley. **Shallow Water Minesweeping for Amphibious Operations**. Melbourne, Victoria: Department of Defence, DSTO, 2000.
REPORT NUMBER: DSTO Technical Report No. 1035

Williams, K. E., et al. **Proceedings of the Ship Control Systems Symposium (5th)**, **Held at U. S. Naval Academy**, **Annapolis**, **Maryland on October 30 - November 3**, **1978**. Volume 5. Annapolis, MD: David W. Taylor Naval Ship Research and Development Center, 3 November 1978. 241p. [See also Volume 6, **ADA159086.**]
ABSTRACT: Partial contents: A New Look at Some Old Ship Handling Problems Employing CAORF's Man-in-the-Loop Ship Simulator; Red or White Light on Ship Bridges; Ships Pilotage in Britain - Past, present, and future; Criteria Optimized by Collision Avoidance Strategies; FFG-7 Class Propulsion Controls - Design and dynamic performance; Simulation and Performance Evaluation of a Mine Countermeasures Vessel Concept; Propulsion Control Optimization of Controllable Reversible Pitch Propeller Driven Ships; A Microprocessor-Based Stabilizer Fin Control System; Use of Micro Processors in Surface Ships Bridge Control Systems; Microprocessor Software - A structured approach to control & surveillance software for marine applications; and Propulsion Control System for the 1980's.
ACCESSION NUMBER: ADA159085

Wilson, Steve L. **The Naval Assault on Gallipoli Going for Broke or Just Broken.** Quantico, VA: Marine Corps Command and Staff, 2002. 57p.
ABSTRACT: When analyzing the 1914 Allied naval assault on Gallipoli, it becomes clear that there are two predominant arguments in support of the conclusion that the assault was the product of faulty military strategy and was thus doomed to failure from the start. The first

argument asserts that even if the ships would have been able to make it through the straits, they did not possess the power to force the capitulation of Turkey. While there is much speculation in support of this assertion, there is equally as much speculation leading to the conclusion that if the fleet had made it through the Dardanelles, Constantinople would have fallen to the Allies. The fall of Constantinople would subsequently have lead to the collapse of the Turkish alliance with Germany. While this question can never be positively resolved, the preponderance of evidence does seem to suggest that it was reasonable to believe that a purely naval strategy could have been successful in bringing about the defeat of Turkey. The second predominate argument asserts that it was unreasonable to believe that a purely naval force could have forced the straits given the Turkish defenses in that area. While exploring this assertion, it becomes clear that forcing the straits would not have been easy. However, it was a calculated risk that had every chance of succeeding. Given the Allied advantage in firepower, the limitations of the Turkish batteries, and the capabilities of determined minesweepers, it is certainly reasonable to believe that it could have been accomplished. Given the reasonable assumption that a purely naval operation was not the product of poor military strategy doomed to failure from the start, it would then seem that poor execution had caused the plan to fail. Arguably, many things could have altered the outcome of this operation. Despite this, the evidence clearly shows that after the 18th of March, the Allies had a clear and strong advantage.

ACCESSION NUMBER: ADA406225
http://handle.dtic.mil/100.2/ADA406225

Wire Sweep Monitoring Equipment (WSME) Test Report. Test and evaluation report. Panama City, FL: Naval Coastal Systems Center, December 1988. 58p.
ABSTRACT: Naval Sea System Command tasked Naval Coastal Systems Center to evaluate the Wire Sweep Monitoring Equipment (WSME) which is currently in production by BAJ LTD for use on the UK Royal Navy River Class Fleet Minesweepers. The US Navy is building two new classes of mine countermeasure ships (MCM-1 and MHC-51) and the usefulness of WSME is being evaluated for applicability to these new ships. The WSME system offers the potential for improvement in performance to both in-service and developmental mechanical minesweeping equipment. The objective of this test were to evaluate the concept of sweeping by tension using WSME: Verify, using Size 1 equipment towed from an MSO class ship, that a flat mechanical minesweeping profile could be achieved and maintained by towing at a constant tension, and compare sweeping by tension to the conventional sweeping by ship speed and define in terms of hog/sag the advantage and disadvantages of each method.

ACCESSION NUMBER: ADA208751
http://www.dtic.mil/dtic/tr/fulltext/u2/a208751.pdf

Withington, V. **Location and Navigation in Mine Counter-Measures Operations.** New Haven, CT: Yale University, Laboratory of Marine Physics, November 1954. 44p.
ABSTRACT: None available.

ACCESSION NUMBER: AD0051756

Woodfin, R. L. **Rigid Polyurethane Foam (RPF) Technology for Countermine (Sea) Program -- Phase 1**. Albuquerque, NM: Sandia National Laboratories, January 1997. 178p.
ABSTRACT: This Phase 1 report documents the results of one of the subtasks that was initiated under the joint Department of Energy (DOE)/Department of Defense (DoD) Memorandum of Understanding (MOU) for Countermine Warfare. The development of a foam that can neutralize mines and barriers and allow the safe passage of amphibious landing craft and vehicles was the objective of this subtask of the Sea Mine Countermeasures Technology program. This phase of the program concentrated on laboratory characterization of foam

properties and field experiments with prefabricated foam blocks to determine the capability of RPF to adequately carry military traffic. It also established the flammability characteristics of the material under simulated operational conditions, extended the understanding of explosive cavity formation in RPF to include surface explosions, established the tolerance to typical military fluids, and the response to bullet impact. Many of the basic analyses required to establish the operational concept are reported. The initial field experiments were conducted at the Energetic Materials Research and Testing Center (EMRTC) of the New Mexico Institute of Mining and Technology, Socorro, NM in November 1995 through February 1996.

REPORT NUMBER: SAND-96-2841
ACCESSION NUMBER: DE97004361
http://dodreports.com/pdf/ada476384.pdf

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DOCUMENTS

Dye, David C. **High Frequency Sonar Components of Normal and Hearing Impaired Dolphins**. Monterey, CA: Naval Postgraduate School, 2000. 85p.
ABSTRACT: A data acquisition device was constructed and tested to obtain toothed whale (Bottlenose Dolphin and Beluga Whale) sonar signals and digitally store them to a PC hard drive. The device had the capability of capturing sonar signals by means of a two-hydrophone array, and a digital video camera in a submersible housing. Cooperation with marine biologists at SSC San Diego enabled the sampling of three animals performing echolocation tasks. Their sonar signals, transmissions of rapid high frequency pulses called clicks, were recorded for further processing. Once the data was captured on video and hard disk drive, it was processed using MATLAB. Data from three different toothed whales, a normal Bottlenose Dolphin, a Bottlenose Dolphin with a hearing impairment and a Beluga Whale, was analyzed. It was observed that the animals reduced the interval between clicks when they located a target. Correlating the signal data to the video data made this observation possible. It appeared the animals searched with widely spaced clicks, then narrowed the click period upon target detection. Also, it was noted that the frequency of isolated clicks decreased as click period decreased. However, the hearing impaired Dolphin maintained his click frequency regardless of click periodicity.
ACCESSION NUMBER: ADA384477
http://handle.dtic.mil/100.2/ADA384477
http://edocs.nps.edu/npspubs/scholarly/theses/2000/Sep/00Sep_Dye.pdf

Evans, William Eugene and James S. Leatherwood. **The Use of an Instrumented Marine Mammal as an Oceanographic Survey Platform**. NUC Technical Publication, no. 331. San Diego, CA: Naval Undersea Research and Development Center, 1972.
ABSTRACT: The paper reports the second phase of an effort to use instrumented marine mammals to measure selected environmental parameters and to relay data on these parameters to tracking aircraft and ultimately to orbiting satellites. A Pacific common dolphin, Delphinus delphis, was fitted with an instrument package and tracked from shipboard and from specially equipped Navy S-2D aircraft. The preferability of smaller odontocetes over larger mystictes as environmental survey platforms was demonstrated. Data collected compared favorably with data from previous radio tracks and with on-site measurements using conventional sampling techniques. Maximum transmitter range and optimum tracking and data collection altitudes were demonstrated for present systems.
ACCESSION NUMBER: AD0754761

Fortescue, Paul, et al. **Marine Mammals and Active Sonar**. Dartmouth (Canada): Defence Research and Development Atlantic, 2005p. 29p.
Abstract: The purpose of this paper is to provide a recommendation to MILOC MG 40 for MILOC engagement with marine mammal mitigation measures, paying regard to the limited resources and special role of MILOC. (Extract from the minutes of the 35th MILOC SG dated 1 November 2004.) The paper does not provide a comprehensive review of the considerable amount of work in progress in this field. It is no more than a brief statement of common understanding of the issues with their potential significance to the MILOC community and an outline of ongoing actions to address the issues. Options and recommendations for MILOC engagement are presented in conclusion.
ACCESSION NUMBER: ADA475349
http://handle.dtic.mil/100.2/ADA475349

Gisiner, Robert C. **Survey of Navy Funded Marine Mammal Research and Studies FY 00-01**. Washington, DC: Marine Mammal Commission, 2001. 192p.
Abstract: The enclosed report is submitted in response to your annual letter to the Office of the Assistant Secretary of the Navy for Research, Development and Acquisition, requesting information on marine mammal related research conducted or supported by the Navy in the previous fiscal year (FYOO), and planned for the current fiscal year (FYO1). Navy investment in marine mammal research for FYOO-O1 shows a continued high level of commitment to advancing our understanding of the unique biology of marine mammals and to promoting the conservation and recovery of these protected marine species.
ACCESSION NUMBER: ADA406014
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Inman, Douglas L. and Scott A. Jenkins. **Scour and Burial of Bottom Mines**. LA Jolla, CA: Scripps Institute of Oceanography, Interactive Oceanography Division, September 2002. 128p.
ABSTRACT: A process-based model was developed to predict the burial of bottom mines. The model has been validated In field experiments conducted on the near shelf off La Jolla, CA. The model was used by SPAWAR/San Diego to evaluate optimal configurations for a mine neutralization device delivered by marine mammals. The model features a coastal classification system to facilitate model initialization for 7 coastal types.
ACCESSION NUMBER: ADA406602
http://handle.dtic.mil/100.2/ADA406602

Lemerande, Tobias J. **Transmitting Beam Patterns of the Atlantic Bottlenose Dolphin (Tursiops Truncatus): Investigations in the Existence and Use of High Frequency Components Found in Echolocation Signals.** Monterey, CA: Naval Postgraduate School, June 2002. 148p.
ABSTRACT: In January 2002, time synchronized underwater pictures and echolocation signals of a free-swimming bottlenose dolphin were recorded. More than 80 experimental trial runs were recorded at the Space and Naval Warfare Center's Marine Mammal Facility in San Diego, California. The apparatus recorded 30 underwater images per second and sonar signals up to 400 kHz. Data analysis shows wide transmitting beam patterns at frequencies lower than 135 kHz contain a majority of the energy in the echolocation signal, agreeing with previously documented work. However, further analysis shows significant energy at higher frequencies. Early in the experiment, the dolphin steered narrow high frequency signals and adjusted the energy content in those different frequencies while scanning the target. To emit these high frequency components, the dolphin changed the wave shape of the emitted sound pulse. As the experiment progressed, the animals task became routine and the high frequency signals were noticeably absent until low frequency noise was projected into the water, at which time the high frequencies were again present in the emitted sound pulses. Resultant transmitting beam patterns provide excellent evidence of the presence of high frequency sound emissions, and also indicate how these signals are used during echolocation tasks.
ACCESSION NUMBER: ADA406289
http://handle.dtic.mil/100.2/ADA406289
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Pomerleau, Dean. **Trained Fish for Littoral Protection: Mine Detection & Defense "Swimmer" Defense**. November 27, 2006.
http://www.fish-school.com/misc/mine_detection.pdf

Ryan, Kendra L. **NATO Undersea Research Centre Marine Mammal Risk Mitigation Rules and Procedures**. La Spezia, (Italy): NATO Underwater Research Centre, 2009. 28p.

Abstract: The NATO Undersea Research Centre (NURC) Marine Mammal Risk Mitigation Rules and Procedures provides the policy and the procedures to scientific planners, Scientists-in-Charge (SID), researchers and the Master of NURC vessels which address potential adverse effects on marine mammals of sea trials involving underwater sound. As a matter of policy, the Centre will take precautionary and preventive measures to circumvent harm to marine mammals from underwater sound by institution of procedures outlined in Staff Instruction 77. As new information becomes available from continued research by the Marine Mammal Risk Mitigation project, as well as other documented sources, these procedures will be re-evaluated and modified as appropriate. This report supersedes the previous NURC report (NURC-SP-2008-003) which included both marine mammal and human diver risk mitigation procedures. These procedures are now separate reports.

ACCESSION NUMBER: ADA511251

http://handle.dtic.mil/100.2/ADA511251

INTERNET SITES

Airborne Mine Countermeasures Association [AMCA]
URL: http://www.amcm.org/
Includes command histories of the various Helicopter Mine Warfare Squadrons

Dictionary of American Naval Fighting Ships [DANFS] – Mine Warfare Vessels
URL: http://www.hazegray.org/danfs/mine/

Federation of American Scientists [FAS] Military Analysis Network DOD 101 – Mines
URL: http://www.fas.org/man/dod-101/sys/ship/weaps/mines.htm
This site provides an overview and history of naval mines. Positions and methods of delivery are also covered.

Naval Mine and Anti-Submarine Warfare Command [NMAWC]
URL: http://www.nmawc.navy.mil/
This the official "war fighting center of excellence for Mine Warfare (MIW) and Anti-Submarine Warfare (ASW)"

Forts Under the Sea: Submarine Mine Defense of San Francisco Bay
URL: http://www.militarymuseum.org/Mines.html
Written by Gordon Chappell, this site provides pictures and a historical overview of the use of minefields used to protect San Francisco Bay from the 1800s through World War II.

A History of the Sea Mine and Its Continued Importance in Today's Navy.
URL:
http://www.history.navy.mil/museums/keyport/The_History_of_the_Sea_Mine.pdf
By Diana Schroeder

Mine Countermeasures - An Integral Part of Our Strategy and Our Forces.
URL: http://www.fas.org/man/dod-101/sys/ship/weaps/docs/cnopaper.htm
White Paper by former Chief of Naval Operations [CNO] Admiral J. M. Boorda.

Mine Neutralization
URL: http://www.fas.org/man/dod-101/sys/ship/weaps/mine_sweep.htm
This site provided by the Federation of American Scientists provides an overview of mine hunting and countermeasures as well as links to various important mine warfare documents captured on their site.

Future of Mine Countermeasures [article-- Coastal Systems Station]
URL:
http://www.fas.org/man/dod-101/sys/ship/weaps/docs/mcmfuture.htm

Theater Mine Defense: The Next Step in the Evolution of Mine Countermeasures.

URL: http://www.fas.org/man/dod-101/sys/ship/weaps/docs/theaterminedefense.htm

MINWARA -- Mine Warfare Association
URL: http://www.minwara.org/
This is a non-profit organization devoted to education and the raising of awareness concerning mines. This site includes the Mine Lines newsletter, announcements and links to other related web sites.

MINWARA Spring 2007 Regional Conference: *Mine Warfare in Sea Shield: Moving Out in New Directions* [with links to presentations]
URL: http://www.minwara.org/Meetings/2007_05/Spring_2007_Agenda.htm

MOMAG [Mobile Mine Assembly Group]
URL: http://www.public.navy.mil/surfor/comomag/Pages/default.aspx
This is the official site of the MOMAG.

U.S. Navy Mine Familiarizer
URL: http://www.public.navy.mil/surfor/comomag/Pages/mines.aspx

National Defense Industrial Association [NDIA] Conference Presentations

2010

The Resource Sponsor Perspective: Current and Future Support for EW MCM By CAPT Mark Rios [15th Annual Expeditionary Warfare Conference, 4-7 October 2010]
URL: http://www.dtic.mil/ndia/2010expedition/RIOS.pdf

2009

N852 Mine Warfare Branch By CAPT Mark Rios [14th Annual Expeditionary Warfare Conference, 16-19 November 2009]
URL: http://www.dtic.mil/ndia/2009expedition/Rios.pdf

2008

U.S. Navy Mine Countermeasures By CDR Dave Hebert [13th Annual Expeditionary Warfare Conference, 20-23 October 2008]
URL: http://www.dtic.mil/ndia/2008warfare/R4Hebert.pdf

2007

Mine Warfare: Preparing to Win, Today and Tomorrow by Rear Admiral John N. Christenson [12th Annual Expeditionary Warfare Conference, 22-25 October 2007]
URL: http://www.dtic.mil/ndia/2007expwarfare/christenson.pdf

U.S. Navy Mine Countermeasures by CAPT Bruce Nichols [12th Annual Expeditionary Warfare Conference, 22-25 October 2007]
URL: http://www.dtic.mil/ndia/2007expwarfare/CAPTNichols.pdf

2004

PMS495 Mine Warfare Program Office by Rear Admiral William E. Landay [9th Annual Expeditionary Warfare Conference, 18-21 October 2004]
URL: http://www.dtic.mil/ndia/2004expwarfare/landay2.pdf

2003

Naval Expeditionary Warfare Update by MAJGEN J.R. Battaglini, [8th Annual Expeditionary Warfare Conference, 21-23 October 2003]
URL: http://www.dtic.mil/ndia/2003war/batt.ppt

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URL: http://www.dtic.mil/ndia/2003war/batt2.ppt

PEO Littoral and Mine Warfare by Mr. Jim Thomsem, [8th Annual Expeditionary Warfare Conference, 21-23 October 2003]
URL: http://www.dtic.mil/ndia/2003war/thom.ppt

2001

Dedicated MCM Force, **Current and Future** by CAPT David Grimland, [6th Annual Expeditionary Warfare Conference, 29 October – 1 November 2001]
URL: http://www.dtic.mil/ndia/2001ewc/grimland.pdf

Assured Access: Expeditionary Maneuver Warfare by CAPT Tom Davilli, [6th Annual Expeditionary Warfare Conference, 29 October – 1 November 2001]
URL: http://www.dtic.mil/ndia/2001ewc/davilli.pdf

Fleet MIW Exercises and Mainstreaming MIW (Planning and Operational Perspectives) by Commodore Rick Rush [6th Annual Expeditionary Warfare Conference, 29 October – 1 November 2001]
URL: http://www.dtic.mil/ndia/2001ewc/rush.pdf

Required Transition Capabilities [6th Annual Expeditionary Warfare Conference, 29 October – 1 November 2001]

URL: http://www.dtic.mil/ndia/2001ewc/rtc.pdf

GWBATGRU Mine Warfare Commander (MIWC) [6th Annual Expeditionary Warfare Conference, 29 October – 1 November 2001]
URL: http://www.dtic.mil/ndia/2001ewc/gwbatgru.pdf

2000

NDIA Mine Countermeasures Support Ship (MCS) Study by Len Gollobin, Mine Warfare Subcommittee [5th Annual Expeditionary Warfare Conference, 23-26 October 2000]
Briefing – http://www.dtic.mil/ndia/ewc/Gollo1.pdf
Report -- http://www.dtic.mil/ndia/ewc/Gollo2.pdf

Instruments of Power Projection...Mine Warfare by CAPT Tom Davilli, MIW & EOD Branch [5th Annual Expeditionary Warfare Conference, 23-26 October 2000]
URL: http://www.dtic.mil/ndia/ewc/Davilli.pdf

1999

Organic Surface MCM Programs & Opportunities by CAPT Timothy M. Ahern, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/ahern.pdf

1999 Inchon MCS-12 by CAPT Buzz Broughton, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/brough.pdf

Vision for Dedicated and Organic MCM Forces by CDR John A. Brown, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/brown.pdf

MCM Requirements for STOM and Assault Breaching by Major General Jan C. Huly [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/huly.pdf

Organic Subsurface MCM Programs & Opportunities by CDR Richard A. Medley, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/medley.pdf

Organic Air MCM Programs & Opportunities by CAPT Louis F. Morris, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/morris.pdf

Surf Zone Assault Breaching and VSW Zone Mine & Obstacle Countermeasures by RADM Curtis A. Kemp, USN [4th Annual Expeditionary Warfare Conference, 1-5 November 1999]
URL: http://www.dtic.mil/ndia/expeditionary/kemp.pdf

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Concepts & Vision, **Dedicated and Organic MCM** by RADM Dennis Conley, USN and CAPT Buzz Broughton, USN [3rd Annual Expeditionary Warfare Conference, 2-5 November 1998]
URL: http://www.dtic.mil/ndia/warfare/conley.pdf

Shallow Water and Surf Zone Breaching Programs by Mr. Dan Crute [3rd Annual Expeditionary Warfare Conference, 2-5 November 1998]
URL: http://www.dtic.mil/ndia/warfare/crute.pdf

Mine Warfare by Mr. Dale Gerry, ASN [3rd Annual Expeditionary Warfare Conference, 2-5 November 1998]
URL: http://www.dtic.mil/ndia/warfare/gerry.pdf

Fleet Engagement Strategy: Mainstream Mine Warfare by RADM William Marshall, USN and CDR Steven Lehr, USN [3rd Annual Expeditionary Warfare Conference, 2-5 November 1998]
URL: http://www.dtic.mil/ndia/warfare/marshall.pdf

Joint Countermine ACTD Demo II Results by CAPT Tim Schnoor, USN and Mr. Walt Rankin [3rd Annual Expeditionary Warfare Conference, 2-5 November 1998]
URL: http://www.dtic.mil/ndia/warfare/rankin.pdf

NATO Mine Countermeasures Force South (MCMFORSOUTH)
URL:
http://www.afsouth.nato.int/organization/CC_MAR_Naples/NAVSOUTH/MCMFORSOUTH.htm
This is the website for the MCMFORSOUTH and has links to press releases and other related information.

NATO Undersea Research Centre (NURC) Home Page
URL: http://www.nurc.nato.int/
The Centre's mission is to conduct undersea research to assist SACLANT (NATO Supreme Allied Commander, Atlantic) and other MNCs in their mission to meet the challenge of the prevention of submarine attacks and the hostile use of sea mines.

Naval Minewarfare Association
URL: http://www.navalminewarfareassociation.com/

This provides a brief history and the mission of the association as well as the list of officers and board members.

Naval Mine and Anti-Submarine Warfare Command [NMAWC]
URL: http://www.nmawc.navy.mil/

Naval Vessel Register – Mine Countermeasures Ships
URL: http://www.nvr.navy.mil/nvrships/s_MCM.htm
This site includes information about the builder and dimensions of the various mine countermeasure ships.

Naval Weapons of the World from 1880 to Today
URL: http://www.navweaps.com/Weapons/index_weapons.htm

NavSource Mine Warfare Ship Photo Index
URL: http://www.navsource.org/archives/mineidx.htm
This site provides photos of the various ships and submarines, historical and current, involved with mine laying and countermeasures

Navy Fact File: Mine Countermeasures Ships
This site provides information about the various mine warfare ship classes and the current ships in those classes.

Mine Countermeasures Ships – MCM
URL: http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1900&ct=4

Minehunters Coastal Ships – MHC
URL: http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1800&ct=4

Navy Fact File: Weapons -- Mines
URL: http://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=700&ct=2
The Navy Department's Fact File provides background and general characteristics for the various types of sea mines used by the U.S. Navy.

Standing NATO Mine Countermeasures Group 1(SNMCMG1)
URL: http://www.manw.nato.int/page_snmcmg1_new_home_page.aspx

Standing NATO Mine Countermeasures Group 2 (SNMCMG2)
URL: http://www.manp.nato.int/Factsheets/SNMCMG2.htm

Total Navy Mine Warfare Craft Strenght by Country
URL: http://www.globalfirepower.com/navy-mine-warfare-craft.asp
As the name implies, this site tracks Navy mine craft by country

Unmanned Vehicles for Mine Countermeasures [Naval Research Advisory Committee (NRAC)]

Executive Summary

URL:
http://www.nrac.navy.mil/docs/2000_es_unmanned_vehicles_mine_countermeasures.pdf

Unclassified Report

URL:
http://www.nrac.navy.mil/docs/2000_rpt_unmanned_vehicles_mine_countermeasures.pdf

U.S. Navy Marine Mammal Program.
URL: http://www.spawar.navy.mil/sandiego/technology/mammals/index.html

U.S. Merchant Ships Sunk or Damaged by Mines in World War II
URL: http://www.usmm.org/mineships.html
This provides a list of US Merchant ships sunk or damaged by date and location.

USA Mines
URL: http://www.navweaps.com/Weapons/WAMUS_Main.htm
This provides a history of US mines including pictures and specifications.

Water Mine Warfare in South Vietnam
URL: http://www.history.navy.mil/wars/vietnam/minesouthviet.htm
By Edward J. Marolda, this give a brief overview of the use of naval mines in the Vietnam War.