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# Mine and Mine Like Objects Classifications through Deep Learning Neural Network Systems

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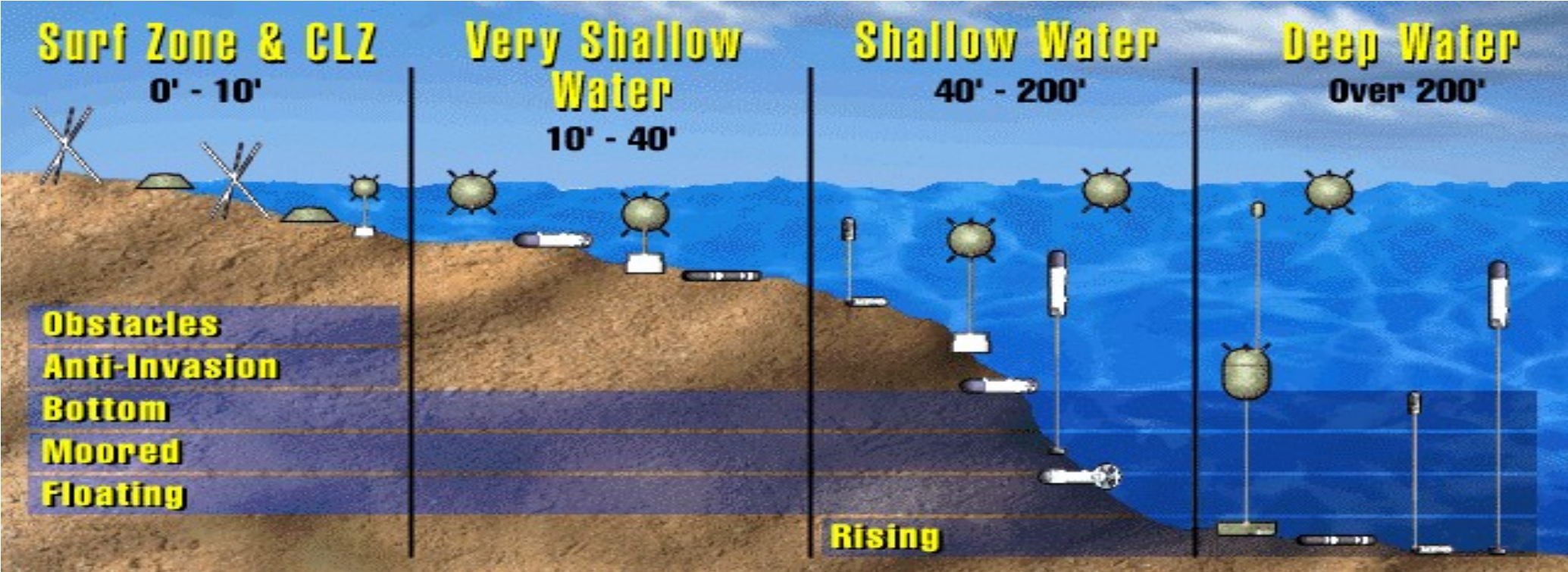
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# **Mine and Mine Like Objects Classifications through Deep Learning Neural Network Systems**

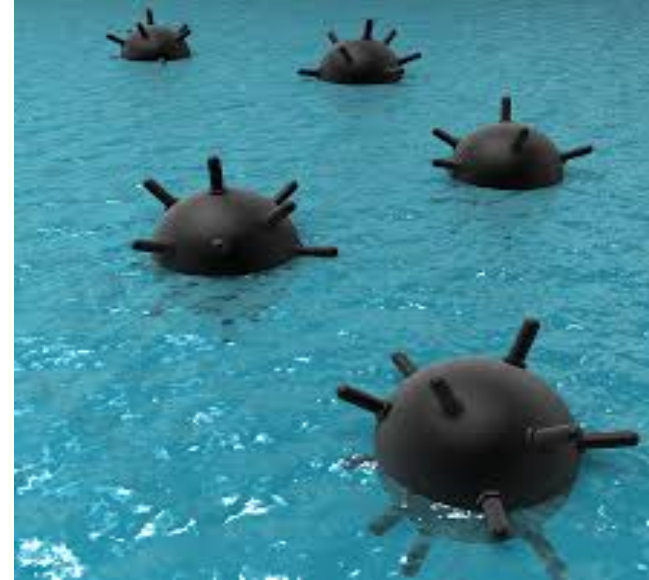
**Sang Ki Joung, Moon Hwan Kim(LIG NEX1), Kwang sub Song, Prof. Peter Chu**

**Naval Ocean Analysis and Prediction Lab, NPS**

# Mine and Maritime Environment



## Mine Burial Scene



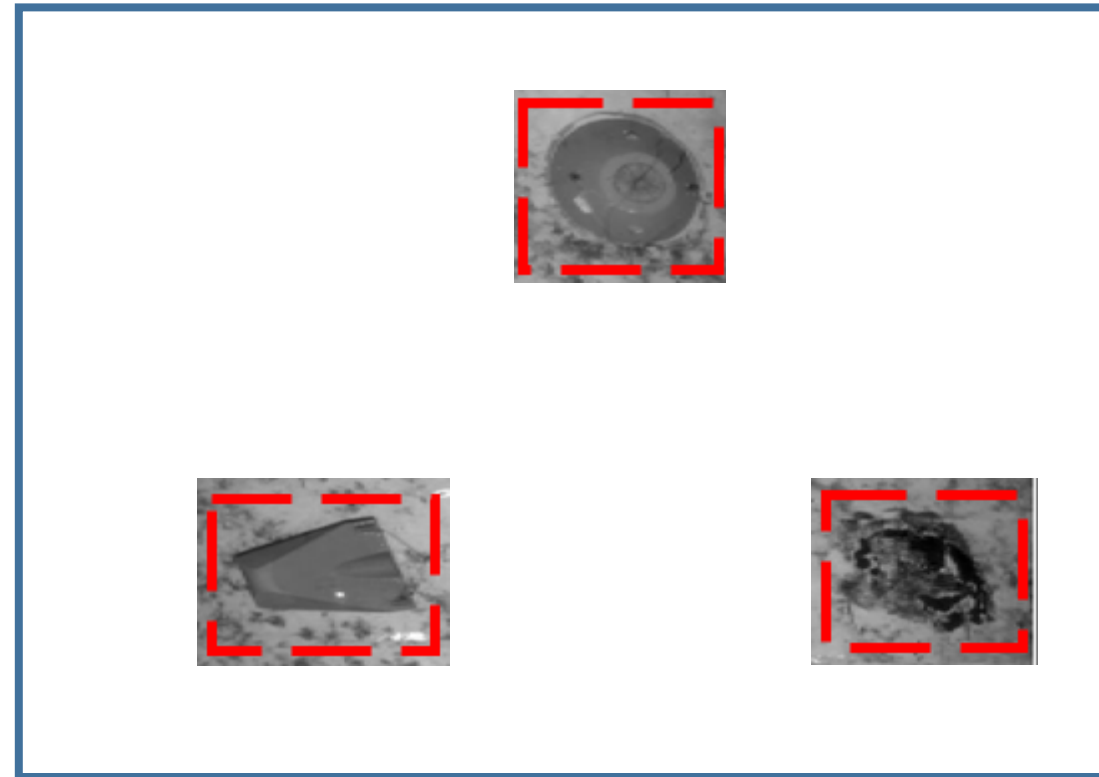
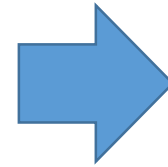
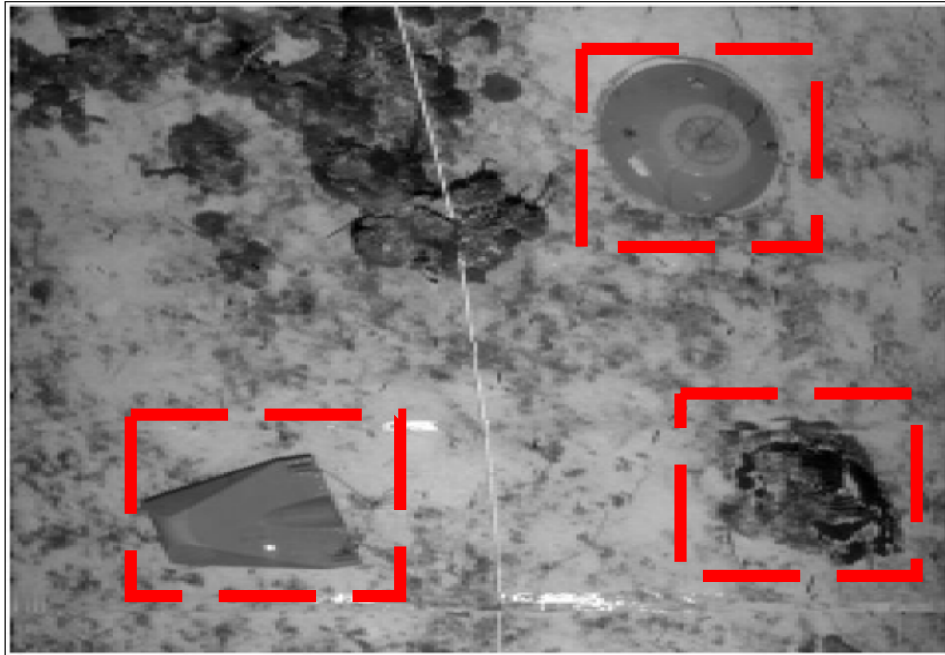
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# Our Objective;

Probable Region Selection for  
Mine Classification and Clearing



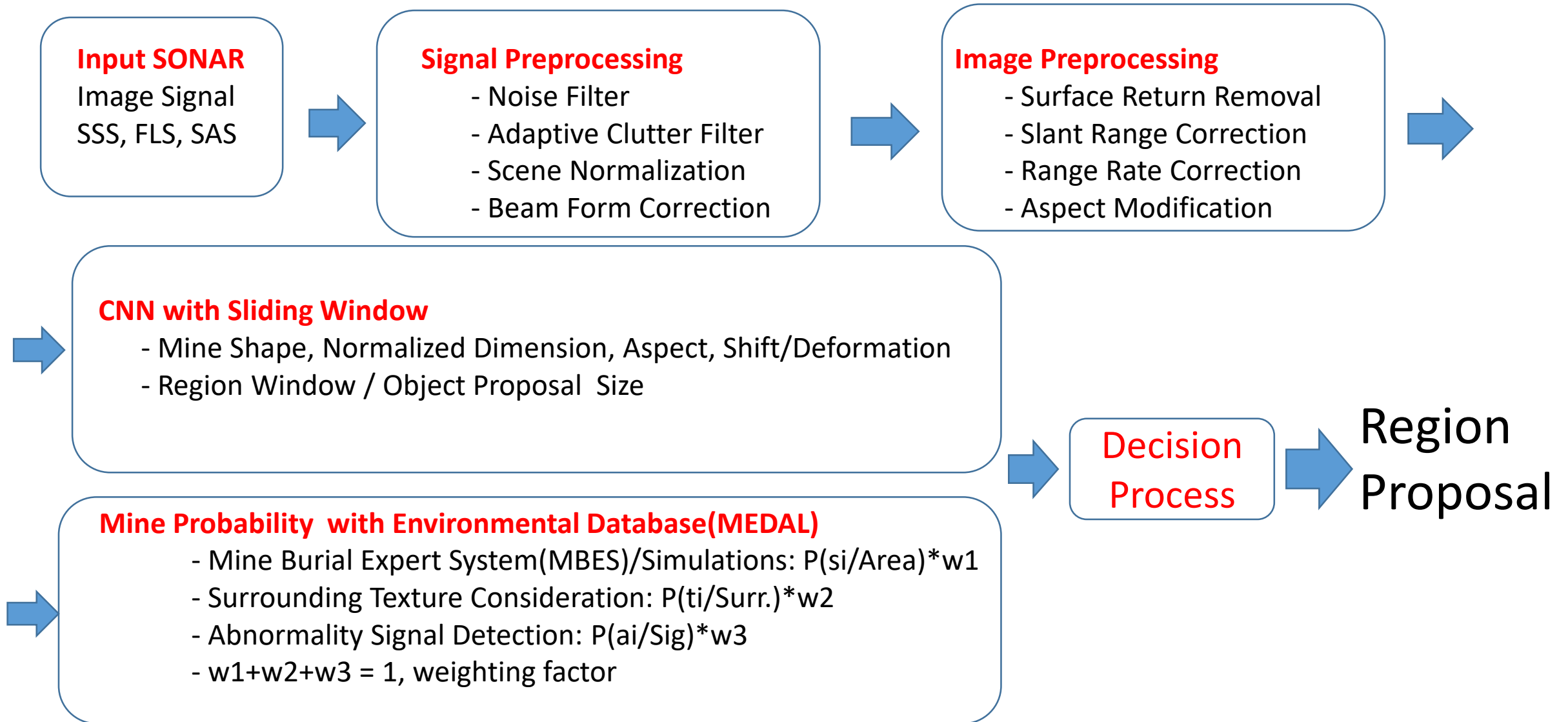
# Justifications

- \*There are plenty of Identification and Classification Algorithms using up to date Deep Learning Method.
- \*Huge training data and Processing Hard Ware with Graphic Processor Unit are required.
- \*Long training time for Neural Networks is problem
- \*Mine and Mine Like Object and their respective SONAR signal data are few and restrictive to access

# Problem Statement

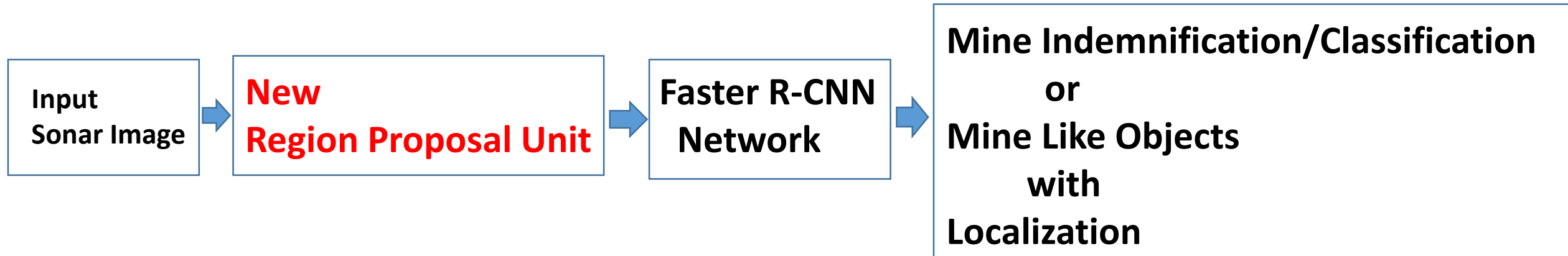
- \* Deep Learning Neural Network needs long processing time and data
- \* We try to separate Region of Interest selection Processing from whole Deep Learning Package for Mine Classification
- \* Region of Interest selectins are combined with Mine Database, Environmental Condition and SONAR signal processing
- \* Selected regions of interest(ROI) are fed through well established Faster R-CNN Package for Classifications

# New Regional Proposal Method



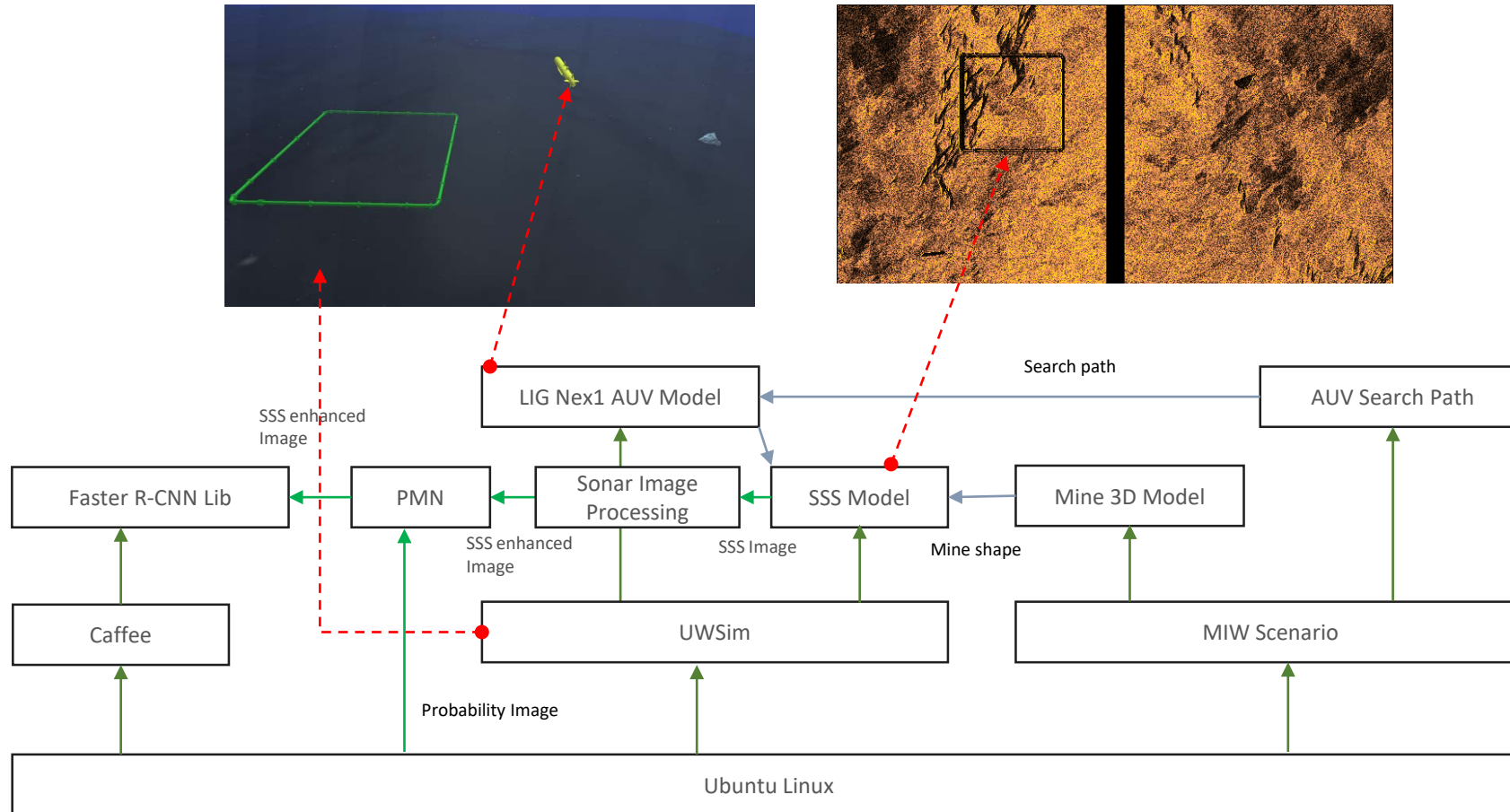


# Overall Mine Like Object Classification System with Faster R-CNN Method



# System Configuration

- System S/W Configuration

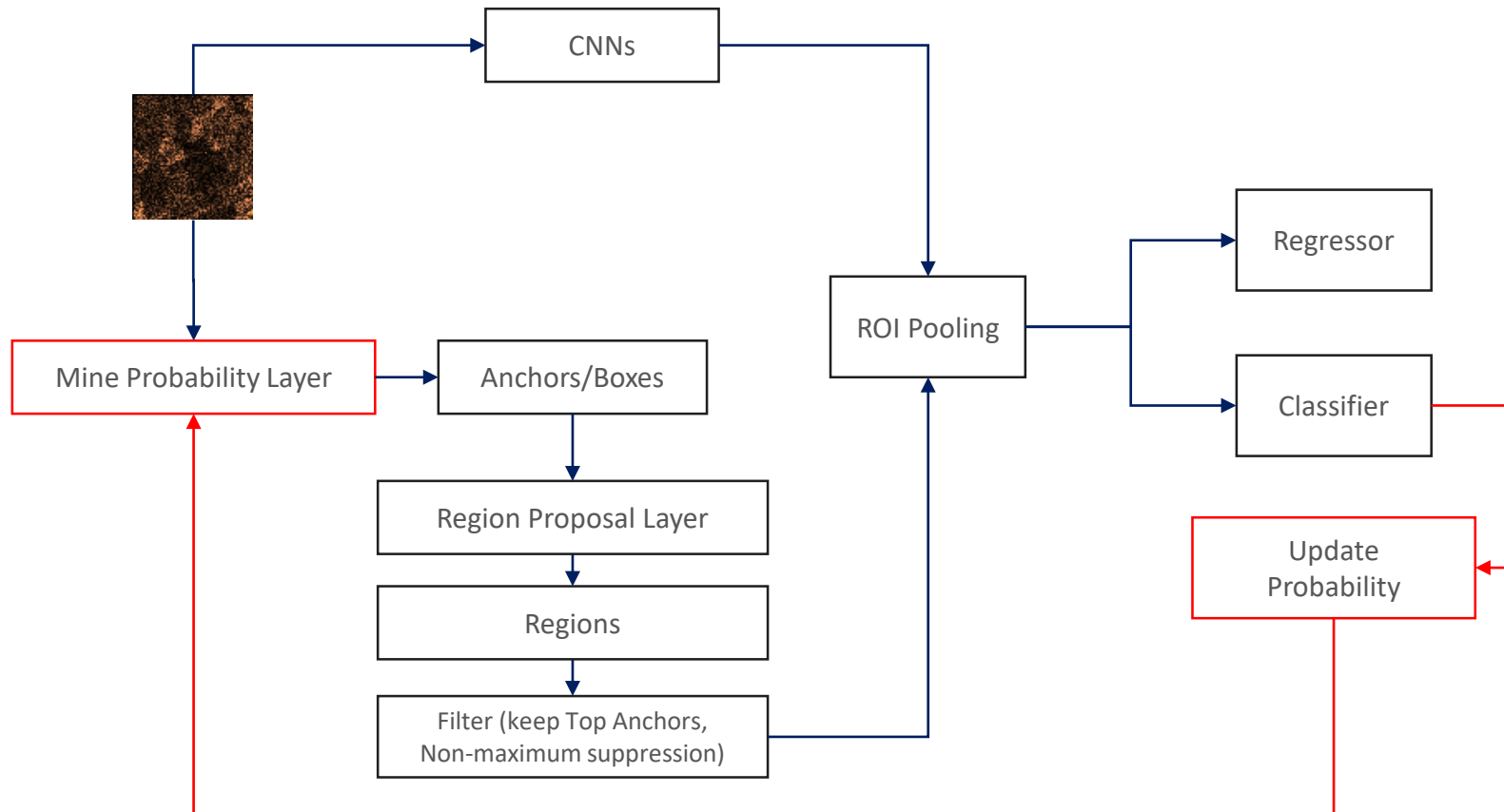


Python + MATLAB + C++ Based SW

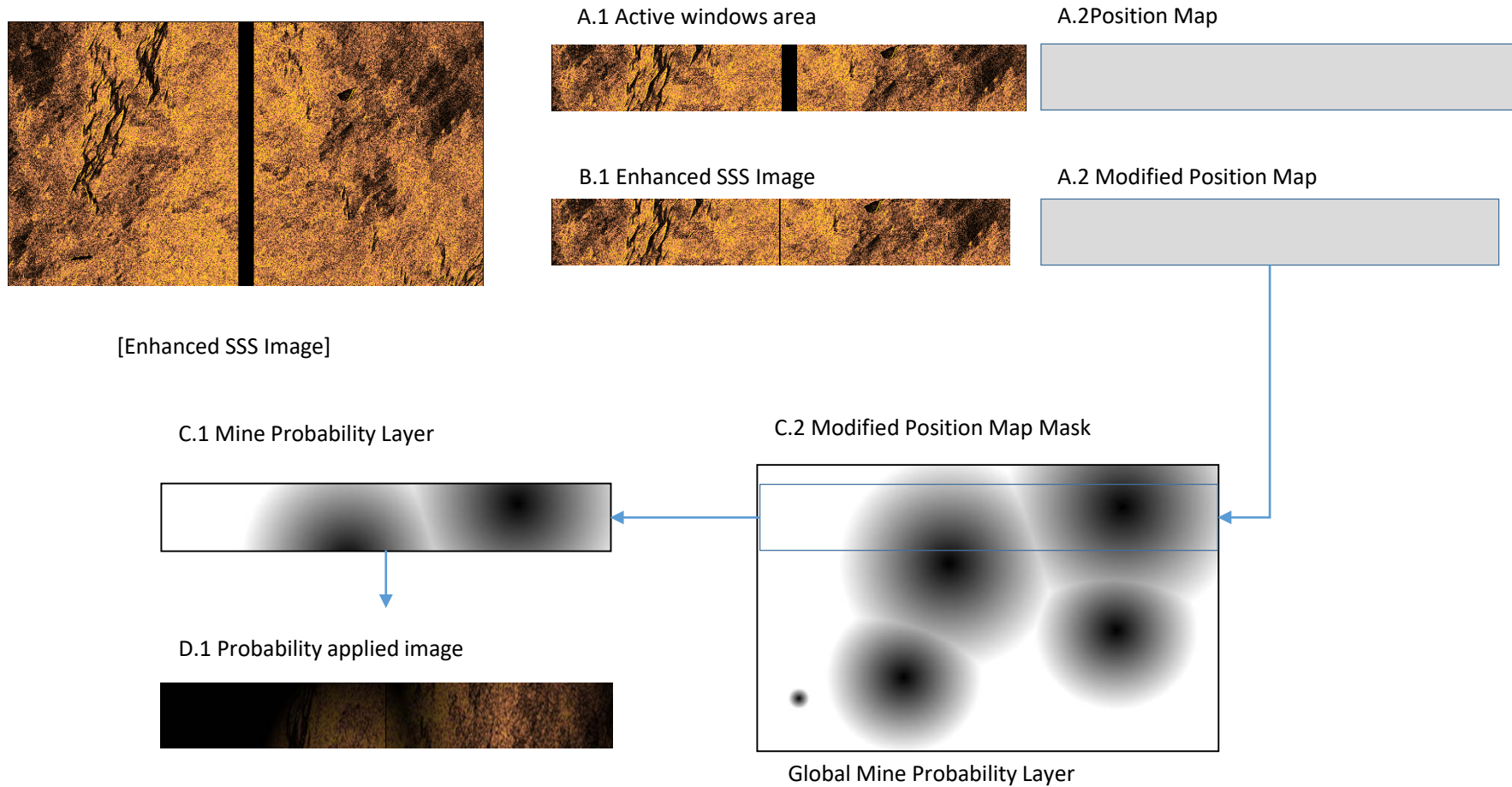
← Inheritance   ← Image data   ← Motion Data

# New Regional Proposal Method for Faster R-CNN

- **New Regional Proposal Method for Faster R-CNN**
  - Add Main probability Layer to before anchoring
  - AUV's position and mine warfare information is reflected in probability layer
  - Reduce the number of ROI by adding probability map (PM) layer
  - Update PM layer's weight from mine classification result

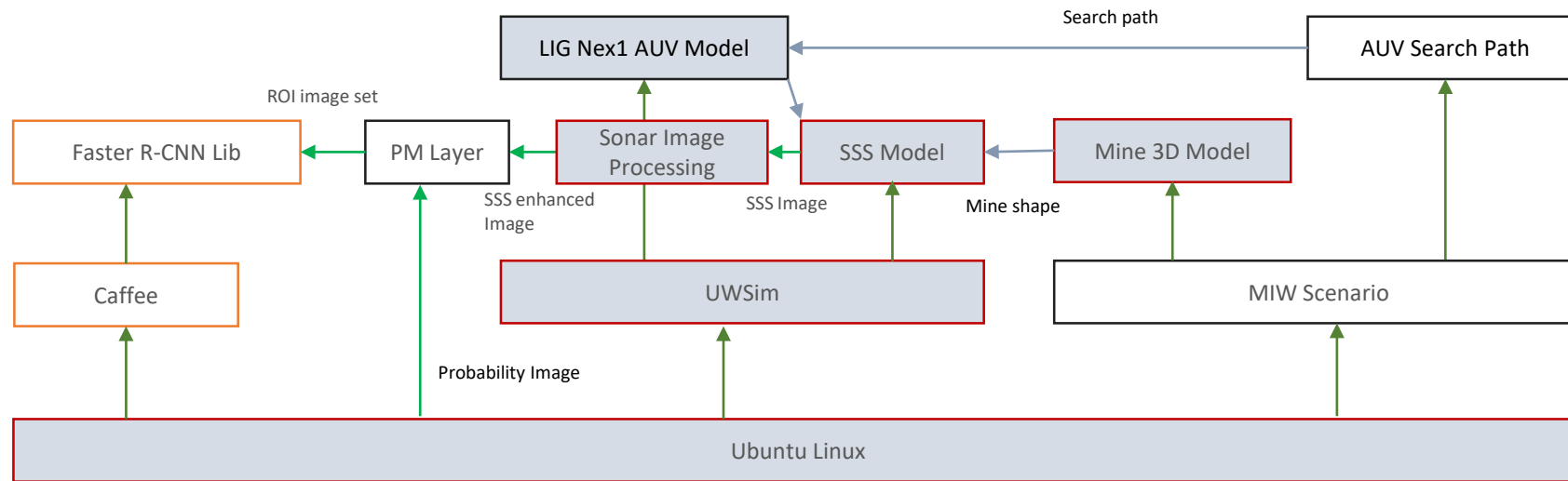


# 3. New Regional Proposal Method for Faster R-CNN



# Implementation

- **Current Research Implementation Status**



On Going recently

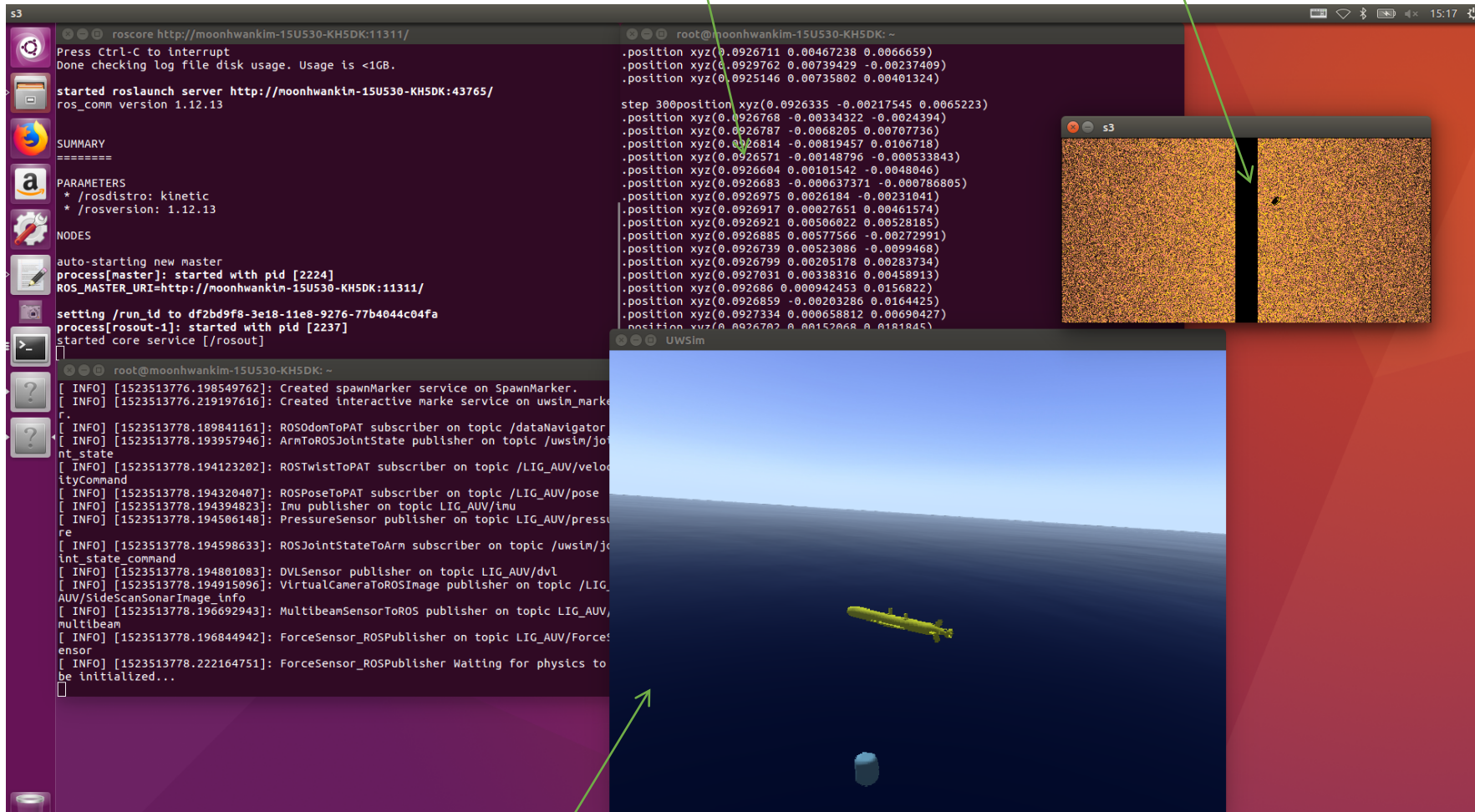
Complete

# Implementation

- A. ROS based Side Scan Sonar Model

Realtime Computing..

Side Scan Sonar Image

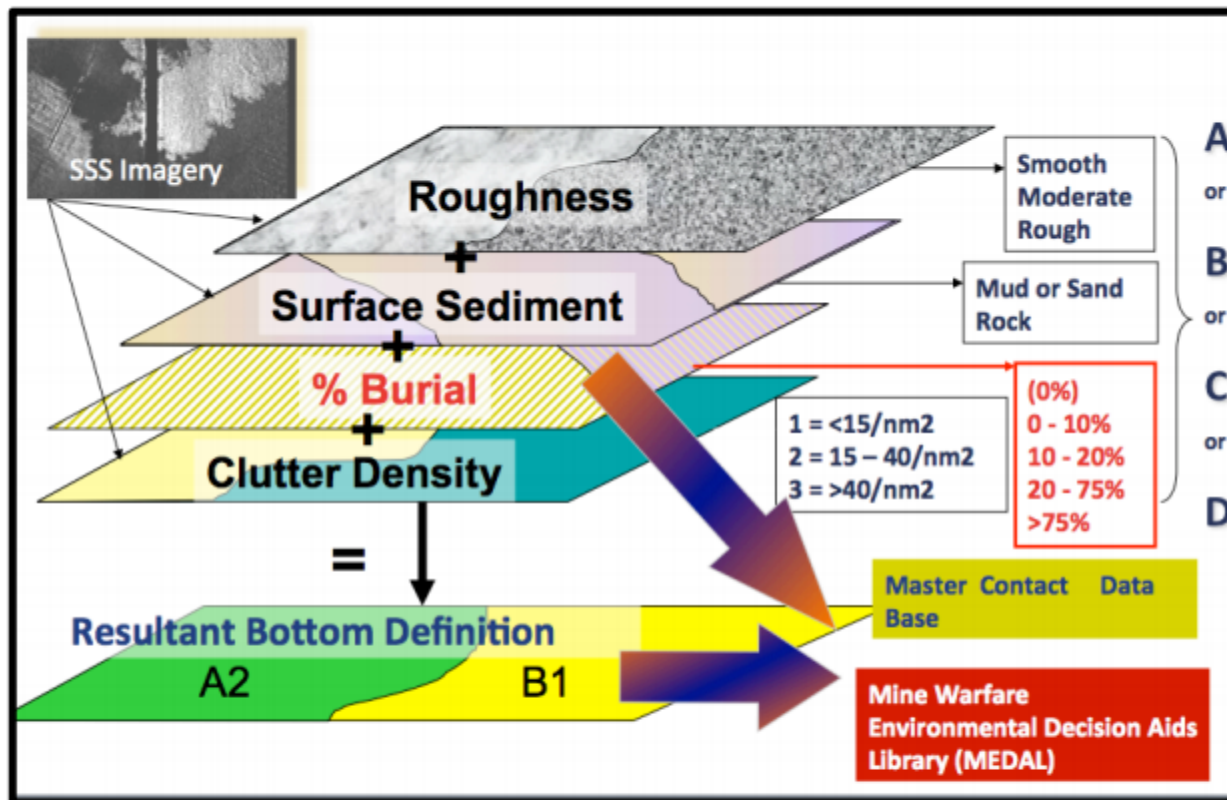


3D Motion window



# MW Bottom Characteristics Requirements

## MW Doctrinal Bottom Analysis Based on NWP 3-15



DBT defines tactics utilized

- Mine Hunt
- Sweep

### MW Doctrine for Burial – Processes

- Impact Burial
- Scour
- Subsequent Burial

Bottom Composition	Predicted Mine Case Burial %	Bottom Roughness	Bottom Category	Bottom Type
Rock	0	Smooth Moderate Rock	B C C	A-D 1-3
Mud or Sand	0 to 10	Smooth Moderate Rock	A B C	
	10 to 20	Smooth Moderate Rock	B B C	
	20 to 75	Smooth Moderate Rock	B C C	
	75 to 100	All	D	

Clutter Category

1  
2  
3

Note: Burial can be impact and/or subsequent

# Example MBES Impact Burial Prediction

from *Sediment Provinces* in NAVO Sediment Databases

