of control parameters during a mission would be extremely expensive. Neural nets have already been applied to numerous pattern recognition problems, and therefore their application to the gain scheduling problem is relevant. The synthesis of neural networks can lead to better interactions with the unknown environments and responses that can be expected with classical control methods and is ideally suited for the AR&D problem. Neural nets provide an efficient way to implement nonlinear estimators and do not require explicit information about the environment.

As with other elements of AR&D, the recursory capture mechanisms are available or under development, but flight credibility is yet to be established. A number of significant test beds exist in support of AR&D at government-owned foreign and contractor facilities. Full credibility is yet to be earned for ground supervised AR&D flight systems to demonstrate sensors, software, mechanisms, and proximity operations. A flight validation program should be our top priority.in support of validating these test beds and methods.

The presentation and discussion afterwards brought out that there are about 40 sensors applicable to AR&D. On the open market there are many more sensors described in classified documentation.

Questions addressed include: Has a study been conducted on managing the AR&D system during communications blackout and is there onboard software to handle this contingency? There is onboard software, but ground intervention is allowed since unforeseen, unplanned events always occur. The study aspect of the question was not answered.

What type of learning is used with neural networks and where does the data come from? The data comes from computer simulation. The type of data includes the impact of various spacecraft masses, sizes, etc.

The main point of Marzwell's presentation was that the technology is available to develop an AR&D system. However, we need to do the system engineering to integrate it.

N93-27446
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p. 2

Autonomous Rendezvous and Capture Development Infrastructure

Thomas Bryan et. al, NASA-MSFC

In the development of the technology for autonomous rendezvous and docking, key infrastructure capabilities must be used for effective and economical development. This need involves facility capabilities, both equipment and personnel, to devise, develop, qualify, and integrate ARD elements and subsystems into flight programs. One effective way of reducing technical risks in developing ARD technology is the use of the Low Earth Orbit test facility. Using a reusable free-flying testbed carried in the Shuttle, as a technology demonstration test flight can be structured to include a variety of sensors, control schemes, and operational approaches. This testbed and flight demonstration concept will be used to illustrate how technologies and facilities at MSFC can be used to develop and prove an ARD system.

To maximize on-flight experiment experience and qualified equipment and minimize program risk and agency costs, the concept uses the existing Spacelab Multi Purpose Experiment Support Structure (MPESS), as a deployable/retrievable target vehicle (by adding a cold-gas three-axis stabilization system) with accommodation for assorted sensors and subsystem tests. A small automated chase vehicle can be adapted from a Lightsat to carry ARD equipment and can fly various 6-DOF separations and approaches. The GPS can be used for rendezvous, MSFC video guidance sensor can be used for final approach, the OMV-derived three point docking mechanism for docking, and the Automated Fluid Interface system for umbilical connection. The chase vehicle is docked and locked onto the pallet after testing and integration, allowing the shuttle crew and the ground processors to handle the experiment as a single integrated payload.

Using the flight demonstration concept as a strawman program, the potential utilization of various facility capabilities at MSFC facilities was discussed, namely: the Dynamic Overhead Telerobotic Simulator, Spacecraft Air-bearing Simulator, Flight Robotics Laboratory, Space Operations and Mechanism Test Bed, Optical Instrumentation Facilities, RF System Test Facilities, and Integration and Environmental Testing. Additional facilities exist at Redstone Arsenal.

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Automated Technologies Needed to Prevent Radioactive Materials from Reentering the Atmosphere.

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Project SIREN (Search, Intercept, Retrieve, Expulsion Nuclear) was created to identify and evaluate the technologies and operational strategies needed to rendezvous with and capture aerospace radioactive materials (e.g., a distressed or spent space reactor core) before such materials can reenter the terrestrial atmosphere, and then to safely move these captured materials to an acceptable space destination for proper disposal. A major component of the current Project SIREN effort is the development of an interactive technology model (including a computerized data base) that explores, in building-block fashion, the interaction of the technologies and procedures needed to successfully accomplish a SIREN mission. The SIREN model will include appropriate national and international technology elements – both contemporary and projected into the next century. To obtain maximum flexibility and use, the SIREN technology data base is being programmed for use on 286-class PCs.

The major technical elements for a successful SIREN mission include: ground and space-based tracking, launch vehicles of needed payload capacity, telerobotic systems, sensors, capture technologies, and space transport, and disposal. However, Project SIREN also will impose specialized requirements including the use of dextrous aerospace systems capable of properly functioning in intense radiation and thermal environments.

The SIREN data base now being constructed will cover all the principal technology elements needed to successfully accomplish a SIREN mission. Inputs to the building block categories also should provide a valuable stimulus to those now investigating automated rendezvous and capture technology and operational requirements.

The data base provides for descriptive material covering applicable nuclear power systems, payloads, satellite orbits, tracking systems, launch systems, capture technologies, and disposal options. The capture technologies include the vehicles and propulsion stages needed to effect capture. Plans are to add the sensors and robotic arm technologies as the program matures. A list of key references is included to provide traceability.

The Mission options include performance of the entire mission of tracking, capture, and disposal or only certain aspects of the mission. Analysis is included in the program to determine the feasibility of using different components in performing a given mission. The date of the mission is input so one can evaluate the specific availability of various technologies. Analysis can be performed in interactive or in the batch mode.