Swing-Free Crane/ Advanced Mobility/Collectives

John T. Feddema

Sandia National Laboratories

Intelligent Systems and Robotics Center

P.O. Box 5800, MS 1003

Albuquerque, NM 87185

Jtfedde@sandia.gov

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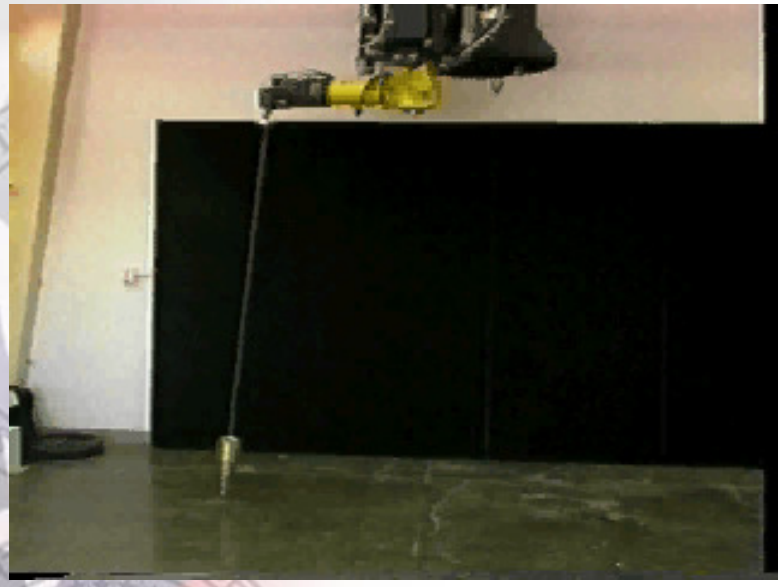
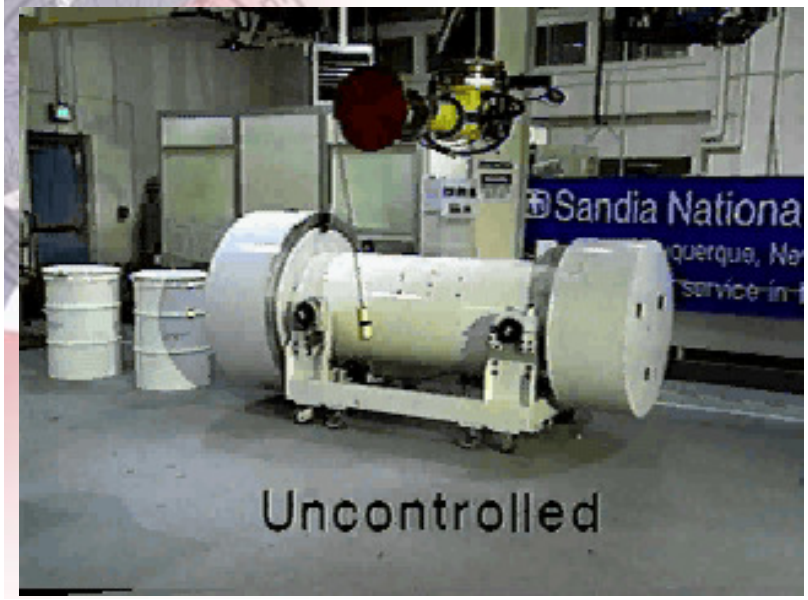
Swing-Free Developed at Sandia for Moving Nuclear Material



Preprogrammed Motion

Gulfport, Mississippi



Operator-in-loop,
Variable Length

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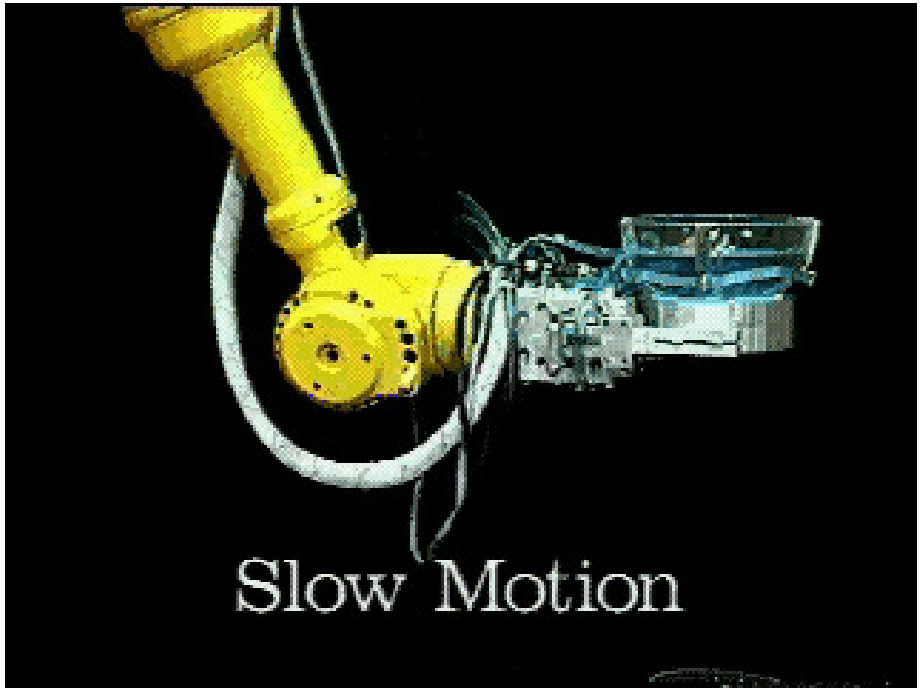
Other Swing-Free Variants

Rotary Crane



Slosh-Free

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1998 NSWCCD Funded Sandia to Determine Applicability of Swing-Free to Shipboard Cranes

Flickertail State, Advanced Crane Testbed

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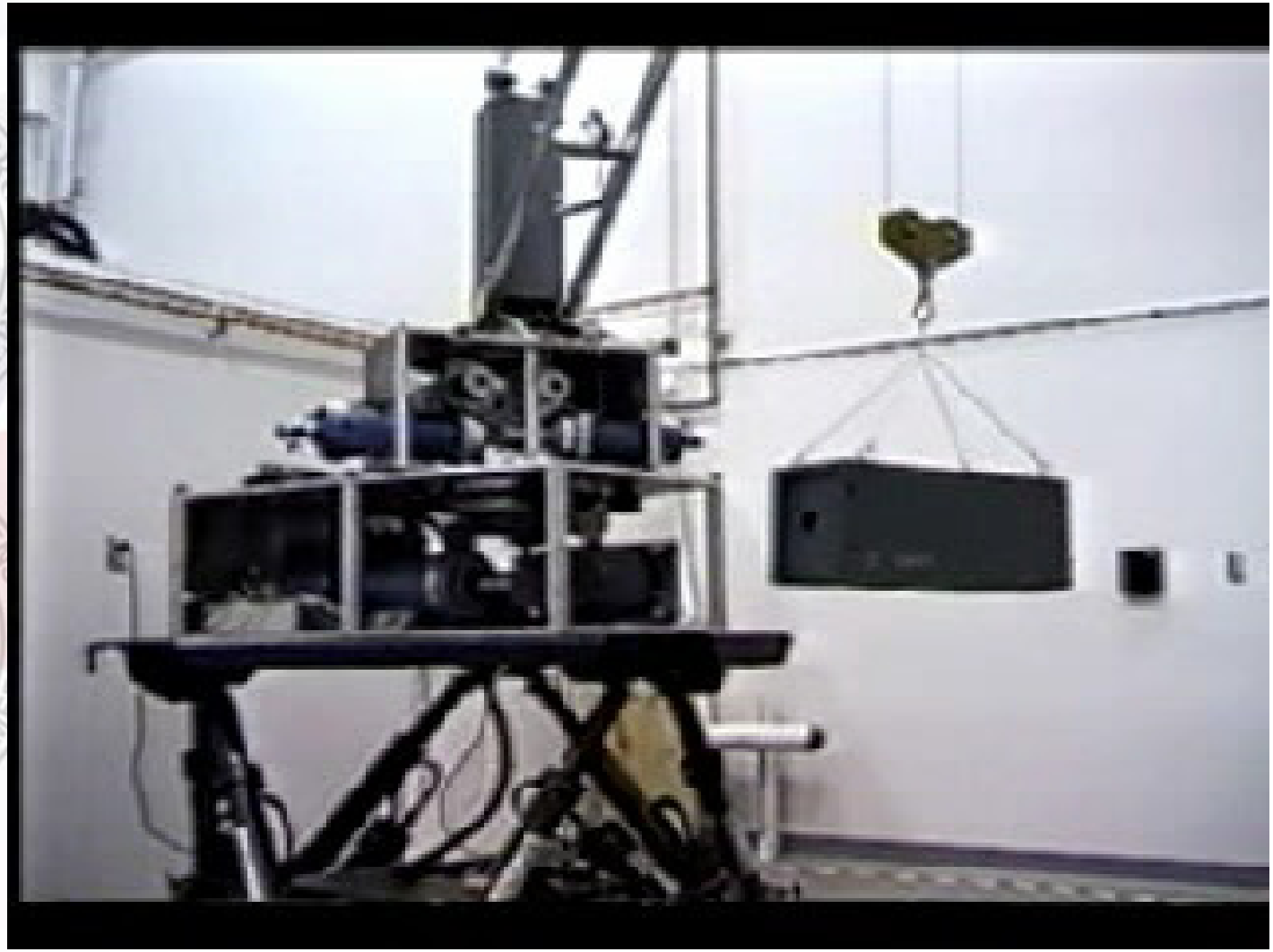
1999 Demonstrated Shipboard Control Algorithms on Sandia 1/16th Scale Crane



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2000: ATD Crane Controller Awarded to Sandia. System ID and Modeling Begun

- Turbo Patriot exercise used to gather crane ship and lighter motion data.
- Extensive modeling of nonlinear crane hydraulic drive system.
- Crane structural vibration modes modeled.

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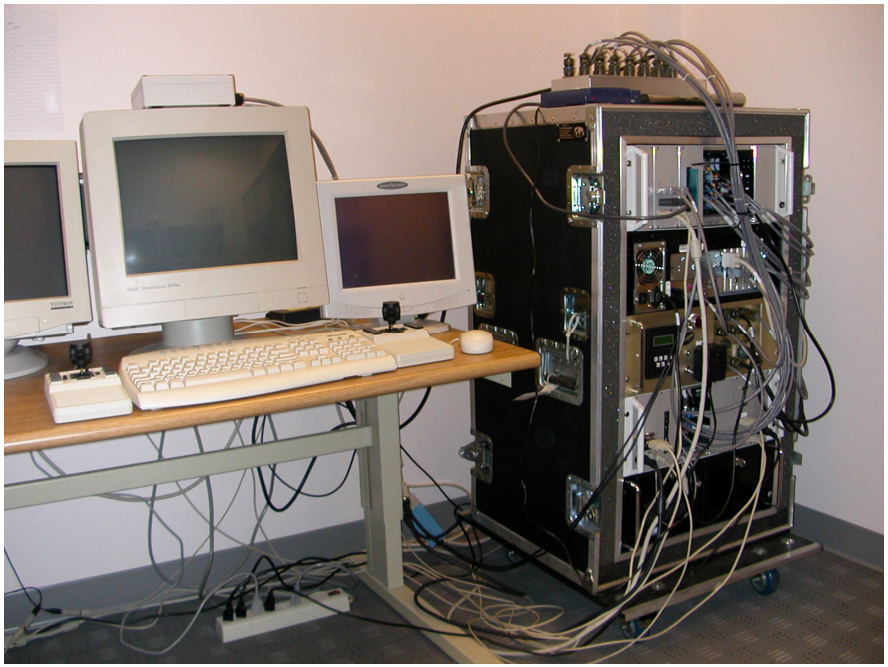
Built Hardware-In-The-Loop Simulator to Facilitate Controller Development

Crane Simulator duplicated all needed electronic signals of crane.

Duplicated hardware and software of CC2000 crane controller.

High fidelity dynamics algorithm derived from detailed crane model.



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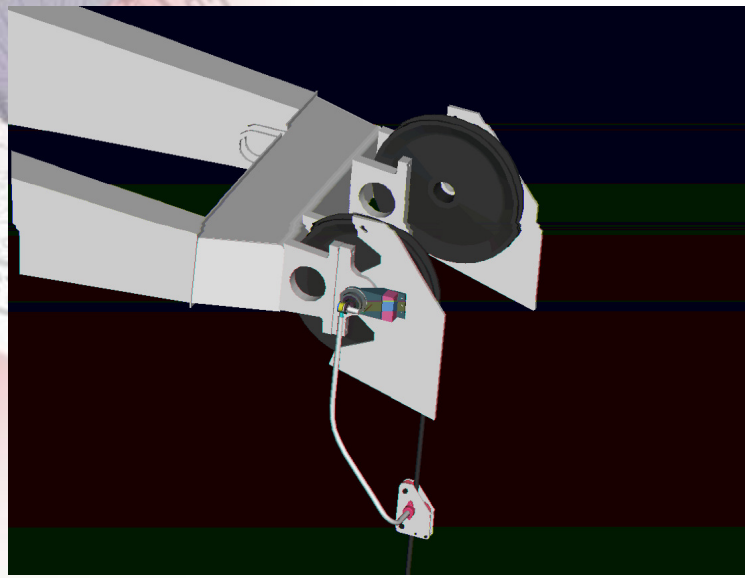
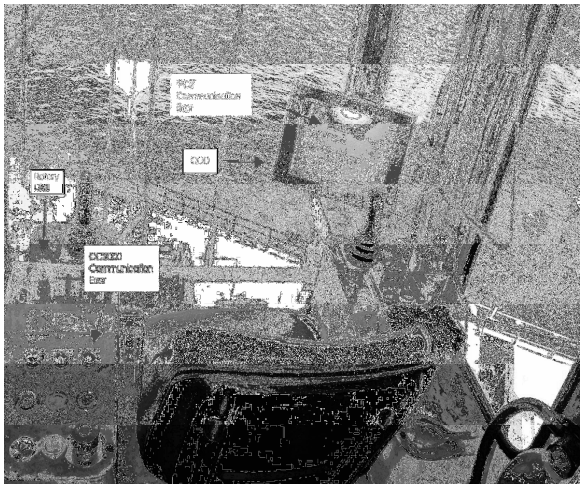
2001 Built/Installed Shipboard Equipment

PCS

Ship motion Sensor



Swing Sensor



Crane Operator Display

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Nov 2002 Pier Side Test

Roll Stimulator provided 2 degree amplitude roll.

RBTS system unsafe at 1 degree amplitude roll.

PCS payload motion safe for 0-2 degrees roll.

- Still some payload motion because of nonlinearities in crane hydraulics (especially actuator saturation).

Craft Roll Stimulator

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Nov 2002 Pier Side Test

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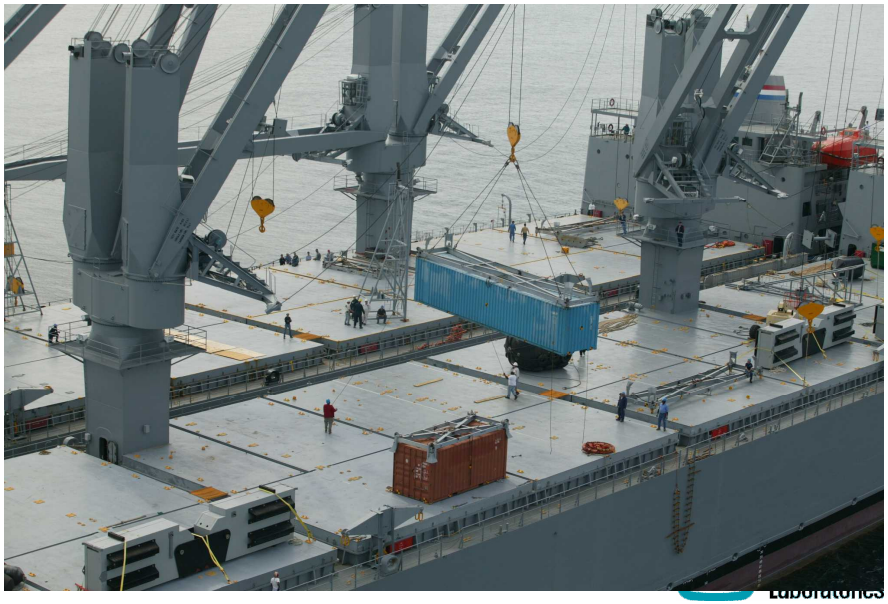
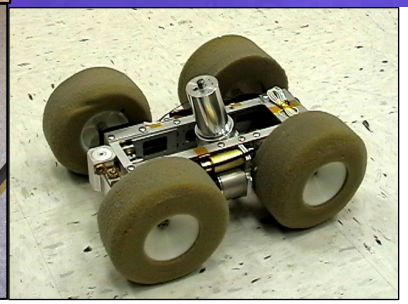
Oct 2003: Underway Replenishment Test

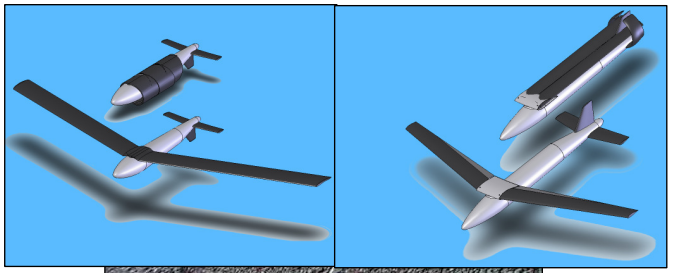
- Payload transferred between Flickertail and Cornhusker State at 3 knots.
- PCS outperformed RBTS systems using payload motion as metric
- Software upgrade for higher speeds was unavailable due to funding limitations.



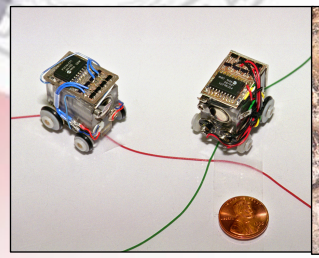
Advanced Miniature-to-Small Mobility

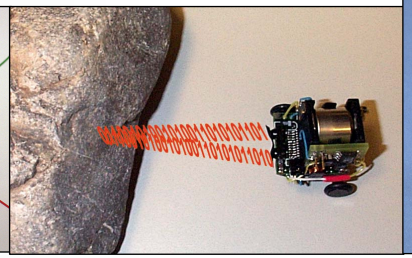


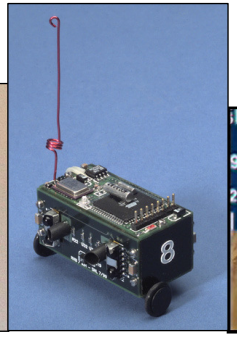
Combustion-Based Hopping Machines

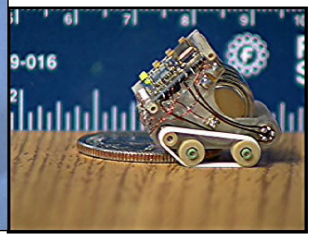


Deployable Unmanned Air Vehicles









Miniature Robots

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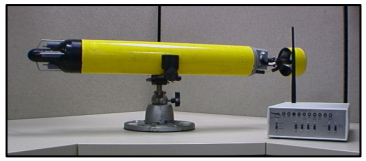
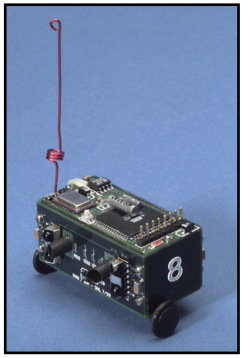
Collective Robotic Systems

Plume Localization
Perimeter Surveillance
Facility Reconnaissance





Plume Localization

Cooperative Target Tracking

Self-Healing Minefield
Cave Reconnaissance

Indoor Communication/
Navigation Network

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Facility Reconnaissance

DARPA PM: John Blitch

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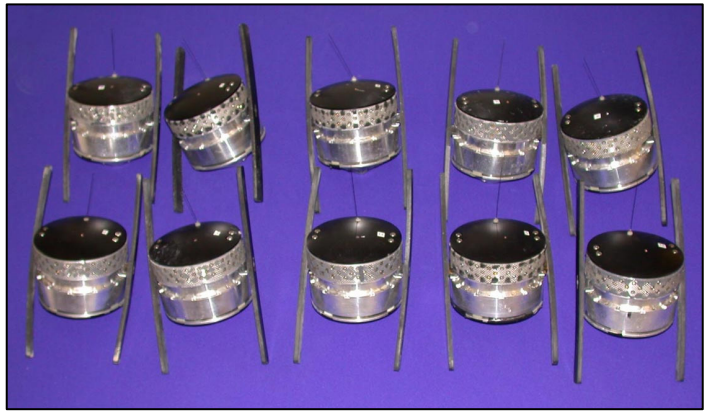
Self-Healing Minefield and Cave Recon



DARPA PM:

Tom Altshuller

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Coverage with/without Boundaries

DARPA PM:

Mark Swinson

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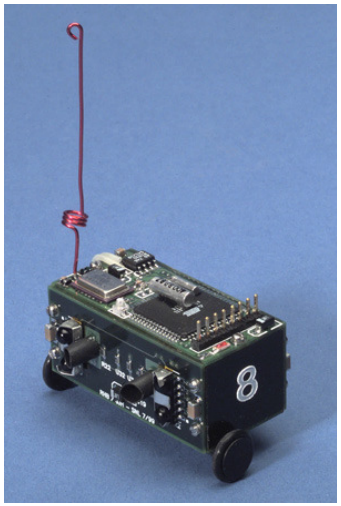
Plume Localization



DARPA PM:

Dick Urban

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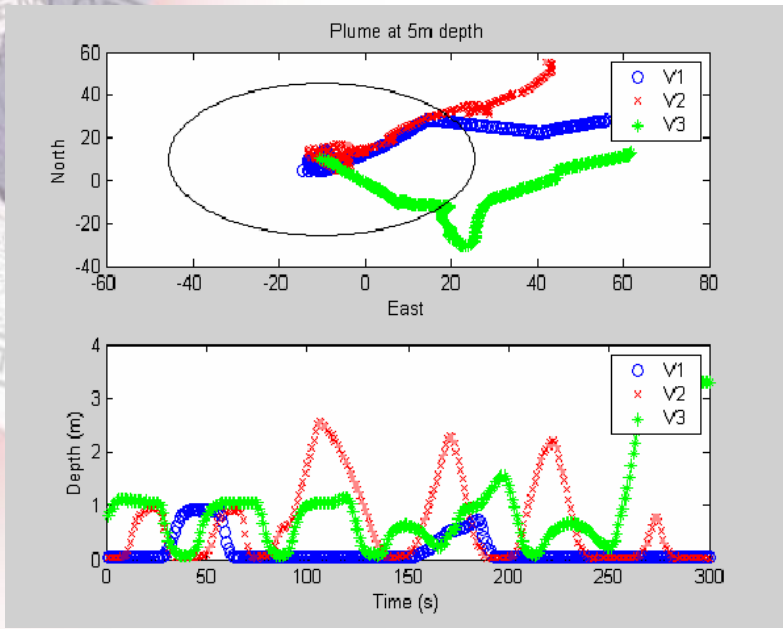
Cooperative UUVs

Nekton Research, LLC
Ranger Micro-UUV



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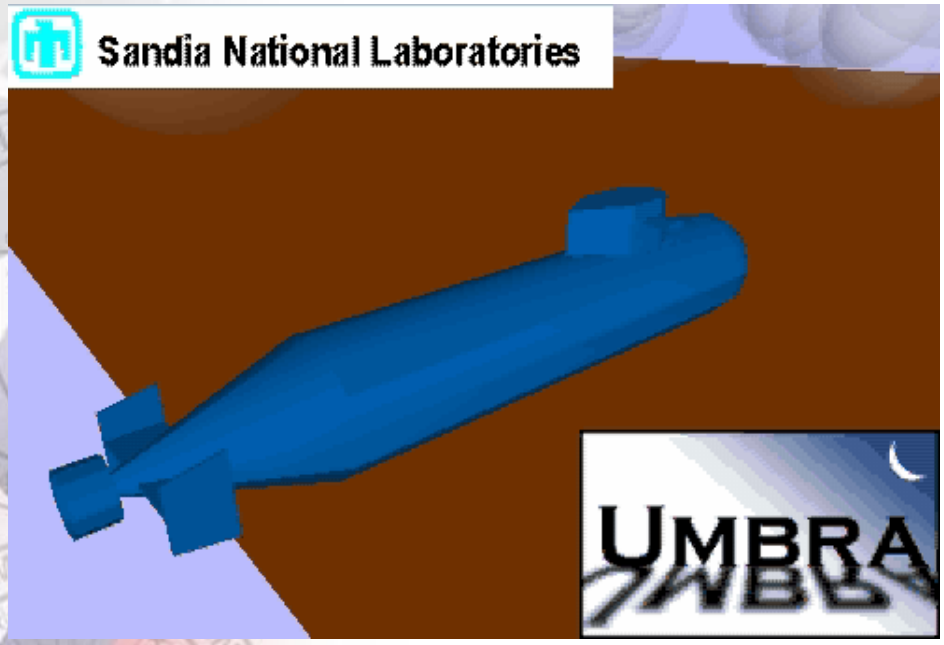
Fixed vs. Mobile Sensor Networks



For 99% Probability of Detection, need 1000 Gliders over 90km x 90km area.

For 99% Probability of Detection, need 29500 Fixed Sensors over 55km x 1km barrier

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