Field Robotics Laboratory
University of Hawaii at Manoa

The Unmanned Port Security Vessel:
A Multi-Sensor Autonomous System for Maritime
and Port Security

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Richard Camilli  (Woods Hole Oceanographic Institution)

Presented at the 11th Annual Research and Industrial Collaboration Conference
October 19th, 2010
The Unmanned Port Security Vessel

Port response and recovery

- Infrastructure and channel inspection
- Change detection
- Threat assessment

First Responder Support

- Getting more ‘boots on the ground’

Small boat harbor surveillance

Multidisciplinary, Multi-Institutional Science and Technology Competition
Multidisciplinary, Multi-Institutional Science and Technology Competition (2009)

- Topic Areas: Multiple sensor integration, and Port systems resilience
- “Effectively develop and integrate multiple sensors and intelligent systems from disparate sources and multiple scales.”
- Requirements:
  - “High quality scientific research” or “Cutting-edge research program”
  - AND
  - “Adding value to DHS an its customers”

Response: Overarching Research Ideas

- The role of unmanned systems in port/harbor security
  - Supervisory control and operator-in-the-loop autonomy
- In-situ sensing and imaging.
- “Data fusion” for maritime remote sensing: “Putting it on the chart”
Operational Scenario: Hurricane Response
Payloads
Testimony to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling
Washington DC, Sept. 27, 2010

Dr. Richard Camilli
Woods Hole Oceanographic Institution
Dept. of Applied Ocean Physics and Engineering
Deep Submergence Laboratory
Robotic subsurface plume mapping using an AUV equipped with a mass spectrometer
Sensor Fusion

Concept

• Put information “On the Chart” for first responders

Implementation

• Interface with USCG Enterprise GIS

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Data Product Format</th>
<th>ArcExplorer Visualization Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathymetry</td>
<td>Rendered bathymetry with colormap</td>
<td>GeoTIFF (raster)</td>
</tr>
<tr>
<td></td>
<td>Contour map</td>
<td>AutoCAD DXF or ArcView Shapefile</td>
</tr>
<tr>
<td>Imagery</td>
<td>Still Images</td>
<td>GeoTIFF (raster)</td>
</tr>
<tr>
<td></td>
<td>Video Imagery (From imaging sonar or optical cameras)</td>
<td>Georeferenced HTML Pop-up</td>
</tr>
<tr>
<td>In-situ Chemical</td>
<td>Rendered chemical concentration maps</td>
<td>GeoTIFF (raster)</td>
</tr>
<tr>
<td>Detections</td>
<td>Individual detections</td>
<td>Georeferenced HTML Pop-up or ArcView Shapefile</td>
</tr>
</tbody>
</table>
1. Real-time environmental monitoring, autonomous change detection

2. In-situ marine chemical sensing

3. Robotic mapping

4. Human-robot interaction
Research and Development

Prototype platform

Sensor integration

Data and information delivery

Timeline:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 2</th>
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<tbody>
<tr>
<td>Hawaii Demo. 1</td>
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<td>Hawaii Demo. 2</td>
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<td>East Coast Demo.</td>
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Transition

Working with USCG R&D Center
(Don Cundy, Jack McCready, Joe Kusek)

Collaborating with National Guard Civil Support Teams (CSTs)

Leveraging DHS COE’s (CIMES, ALERT, CSR)
Acknowledgements

Multiple DHS Centers
- CIMES
- ALERT
- CSR

USCG District 14

Co-PI’s at WHOI

UHM Students
Discussion Questions

Balancing Research and Operations

• From the researcher’s perspective, what’s the primary use?
  – E.g. Single or multi-agency shared, daily or contingency in-port or near-coastal use?

• From the user’s perspectives, what transition roadblocks exist?
  – E.g., Costs, risks, deployment, maintenance, training, integration, etc.

• Can we identify “gaps” in current capabilities?
  – E.g., Sensor fusion, decision aids, determining intent, etc.

Mechanisms for Transition

• Examples of successful transitions from research to reality?

• What are the possible pathways for transition?
  – Traditional:
    University research -> Industry development -> agency acquisition
  – Direct:
    Basic Ordering Agreements (BOAs)

• What is the process for setting DHS requirements?
Recent Accomplishments
First Mapping Survey: Keehi Lagoon
Balancing Research and Relevance

Does basic research add value for DHS stakeholders?

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Transition Questions

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- Traditional:
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  Basic Ordering Agreements (BOAs)

What is the process for setting DHS requirements?

- How does the stakeholder’s experience get codified into system requirements?

What are possible acquisition processes?