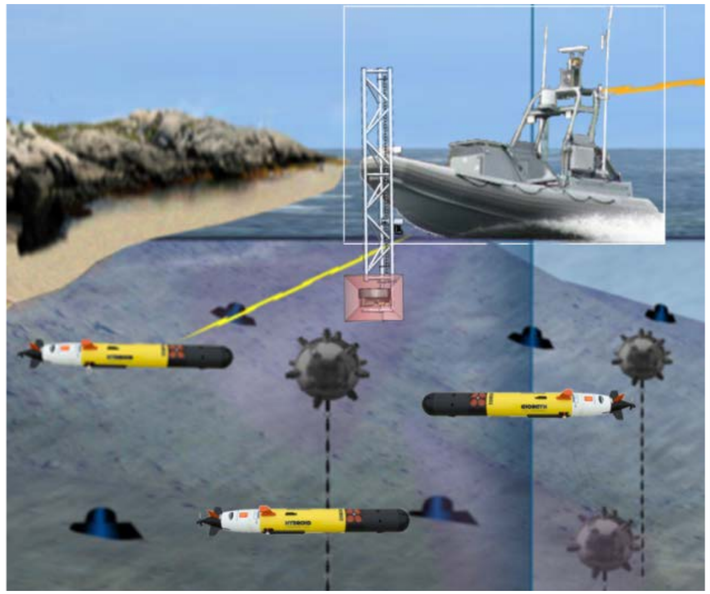
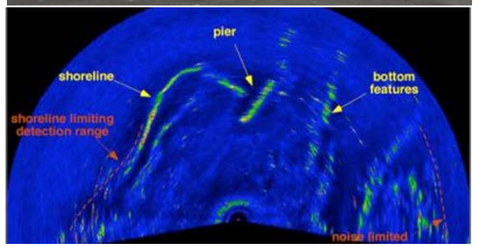
Sensor-Based Motion Planning for Marsupial MCM Teams

Naval Postgraduate School





CONOPS for USV-aided mine countermeasures (left); SeaFox USV equipped with ATLAS sonar (right)

- Single Sortie Detect to Engage (SS-DTE) Mine Countermeasures (MCM)
- Marsupial team: USV can launch, recover, and sustain multiple classes of AUVs for three phases of MCM: 1) detect, 2) identify, 3) neutralize
  - Many complex physical interfaces/interactions between USV and AUVs
  - Sequential MCM phases are still very time consuming
- Question: Can USV with sonar reduce time required for phases 1 and 2?
  - Conduct mine detection via USV in parallel with identification by AUVs
  - USV directs AUVs in real-time in response to new data
  - SeaFox USV has same ATLAS sonar carried by large detection AUVs

- Apply optimal control framework for motion planning that incorporates:
  - Vehicle-specific dynamic constraints
  - Sensor-specific performance models
  - Parameter uncertainty in dynamics or performance function
- Generate USV trajectories that maximize probability of target detection subject to environmental disturbances at the sea surface
  - Models based on experimental data collected with SeaFox/ATLAS
- Generate AUV trajectories that maximize probability of target identification subject to detection uncertainty and AUV sensor characteristics
- Compare simulated MCM execution times to evaluate USV effectiveness

- USV-aided MCM has potential to reduce SS-DTE cost, complexity, and time
  - No need to transport/launch/recover/recharge dedicated detection AUVs
  - More payload avaialable for identification and/or neutralization AUVs
  - USV can share detection data wit h MCM commanders in real-time via wireless network, instead of after AUV mission completion/recovery
- Optimal control can enable intelligent, sensor-based coordinated motion

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