Submarine Force Technology Needs

CEROS

Briefing to Industry

31 August 2004

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Specific Technology Needs

Criteria:

- In-line with CEROS funding and schedule constraints.
- Addresses a significant Fleet need.
- Potential for a unique contribution – complements other work, or little known effort is being applied to the problem.

Expendable ASW UUV

Mission:

To close on potential targets of interest (emphasis on ASW) in order to obtain data allowing improved classification.

ConOps:

1) UUV is covertly launched from the submarine.

2) Fiber tether allows operator control and real-time data return.

3) Operator drives vehicle towards target(s) of interest.

4) Vehicle returns data (acoustic, optical, etc.) to aid in target classification.

5) Vehicle is scuttled once endurance exhausted or all desired data collected.

Project Elements:

- Vehicle modifications: fiber tether, sensor integration, dynamic control.
- Test program, culminating in an operationally oriented at-sea demonstration.
- ConOps development (optional).

High Persistence UUV

Mission: Persistent undersea surveillance with an emphasis on the ASW mission.

System Goals:

- Ability to "loiter" on-station for weeks (could be on the bottom given appropriate sensing conditions).
- Ability to sprint to collect data on targets of interest.
- Autonomous operation (i.e. navigation, target detection, data collection, report-back).
- Communications with command authority (Iridium?), and ability to be re-tasked.
- Ability to proceed to a rendezvous point for retrieval by surface assets.
- Covert submarine launch (optional).
- Ultimate goal of coordinated operations among multiple vehicles.

Project Elements / Technology Considerations:

- Coordination / teaming with the ONR Persistent Littoral Undersea Surveillance (PLUS) initiative.
- Hydrodynamic efficiency / energy harvesting (e.g. solar energy harvesting; energy conversion from currents while on the bottom; - consider teaming with NUWC ATURTLE Concept).
- Hybrid sea-glider / propelled UUV concepts.
- ConOps development (optional).

Environmental Characterization for Improved Weapons Performance

Mission: To take in-situ measurements to characterize the environment so that weapons presets can be optimized leading to improved weapons performance.

System Goals:

- Ability to measure TL, bottom loss, reverberation, etc., within CBASS sonar frequency bands, throughout the depths of operational interest.
- Ability to characterize bottom sediment type / bottom loss to the extent that it significantly influences weapons performance.
- Effective recovery of the collected data, and conversion to weapons preset recommendations.
- Unattended operation during the course of the environmental characterization – i.e. submarine not required to be either source or receiver (optional).
- Compatibility of the data with fleet METOC databases for subsequent use by other platforms.

Project Elements / Technology Considerations:

- Coordination with CBASS Program to determine appropriate presets that could be optimized (e.g. frequency bands, ping intervals, power level, search depth, etc.).
- Coordination with ONR's In-situ Environmental Sensing efforts to leverage vehicle and sensor technology being developed therein.
- ConOps development (optional).

Submarine Retrieval of UUVs

Project Overview:

There may be a desire for the submarine to covertly retrieve high-value unmanned vehicles. The LMRS, and the current MRUUV systems entail retrieval by the submarine, but at considerable expense in onboard footprint and mechanical complexity. This project would investigate the viability (technologically, and from a ConOps perspective) of covert submarine retrieval of smaller payloads with the ability to "swim in" on their own.

Project Goals:

Sub-project A: Assess mission justification for small vehicle "swim-in".

Sub-project B: At-sea demonstration of "swim-in" payload retrieval.

Project Elements *(could be two sub-projects, of which B is of greater interest):*

A
- Investigate the viability of smaller vehicles (e.g. REMUS size - possibly glider / propeller-driven hybrids) for covert submarine missions, building upon current assessments.
- ConOps development – assess the need for covert payload retrieval (ASW, ISR, SOF, etc.).

B
- Development of retrieval system based on payload "swim in", and tracking system.
- Modification of an existing UUV of appropriate size so that it can "swim in".
- Test program, culminating in an at-sea demonstration of "swim in" payload retrieval.

Clutter Reduction Tools

1) Algorithms to automatically (subject to operator concurrence) correlate contacts held on different sensors (various acoustic frequency regimes and propagation paths, visual, radar, etc).

2) Distillation of contacts generating a broad spectrum acoustic signature into a single fundamental contact.

3) Rapid automatic range segregation of contacts whose range may not be definitively determined. Range bins would be >10 Kyds, 5-10 Kyds, 2-5 Kyds, and <2 Kyds. This needs to be done within two minutes with a result of undetermined bin or high confidence (>90%) This process would continue over time and the output would be updated as appropriate.

• Such tools would be intended to transition through the ARCI and/or APB Programs.

TacAid for Large Internal Waves

Applications:

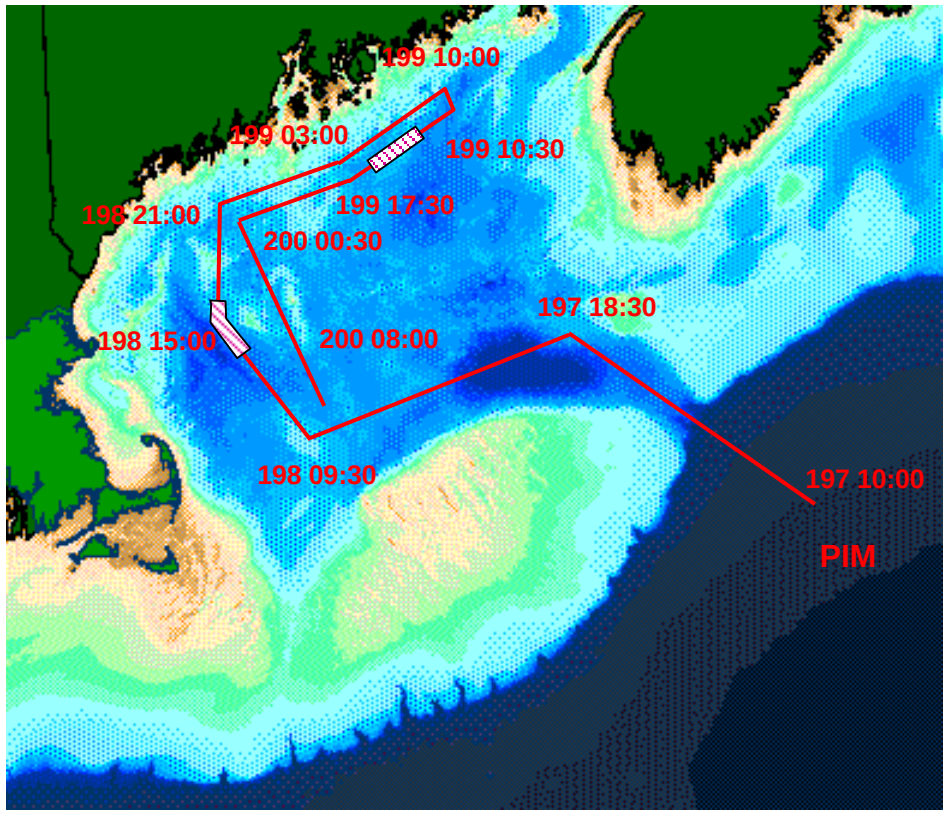
1) Provide warning for operations sensitive to buoyancy fluctuations.
2) Provide warning for acoustic performance anomalies.
3) Allow the acoustic exploitation of Internal Waves (longer term goal)

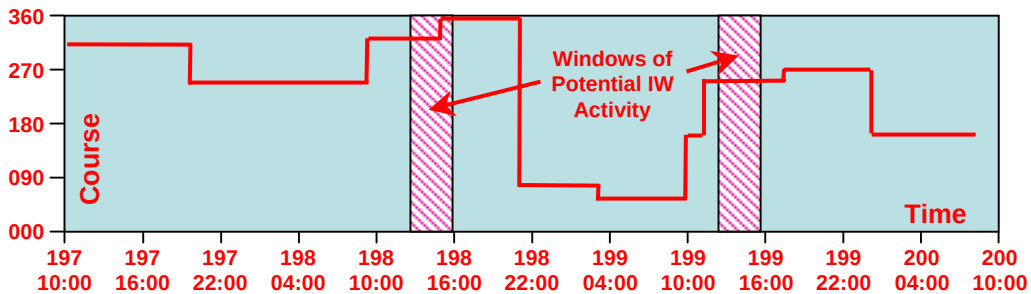
Desired Capability:

Soliton forecast (i.e. when they might occur, vice won't occur) overlaid on PIM and shown on time vs. course plot (see notional display to the right).

Project Elements:

- Project emphasis is on TacAid development and delivery (Fleet interaction is key).
- In partnership with ONR's modeling of IWs.
- Modeling state-of-the-art may not initially support data resolution shown at right.





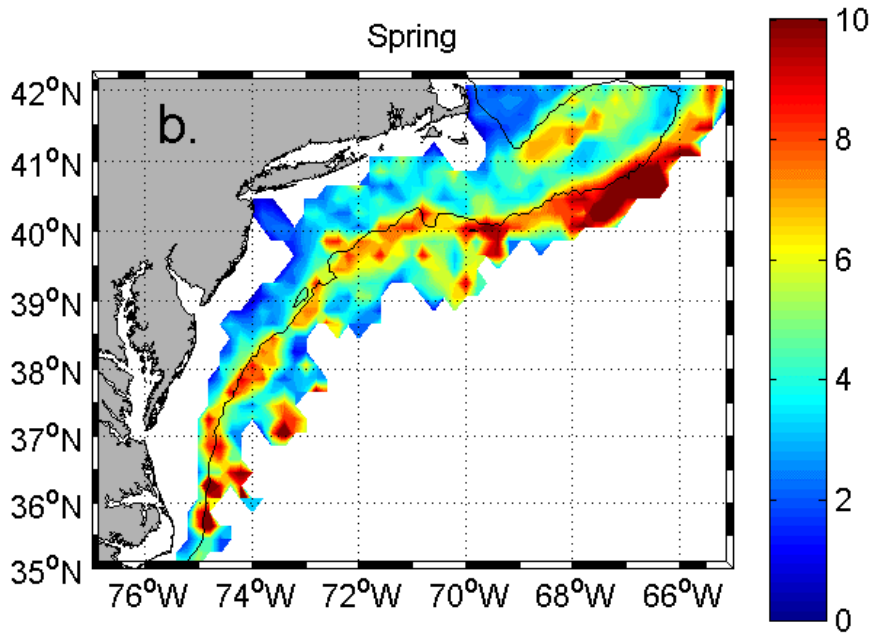
Displays of Uncertainty

Project Goals:

- Develop prototype displays showing the impact of environmental uncertainty. (i.e. the operational “So What?”)
- Show operational metrics, and provide the ability to “drill down” to determine underlying causes of the uncertainty. (i.e. the operational “Why?”)

Project Elements:

- Identify the operational metrics; e.g.
  - time required to complete a search
  - variability of time required to search
- Coordination with ONR Uncertainty DRI and related efforts.
- Coordination with TDA developers (i.e. PC-IMAT and SOWG)
- Plan for integration with mission planning tools.



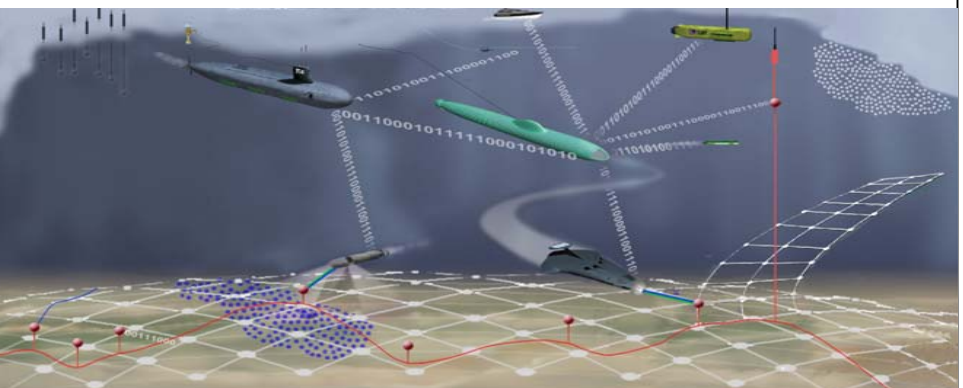
Focus should be on areas of high ***gradient*** of performance.

Technology Needs in General

Comms at Speed / Depth

Problem Description:

- Submarines need the ability to maintain off-hull communications without having to come to Periscope Depth. Applications include:
  - Joint Command and Control
  - Coordinated ASW prosecutions
  - Waterspace management / Combat ID
  - Comms with UUVs and offboard sensors
  - Independent, covert, forward area operations
- Driving goals:
  - Selection of “tools” needs to be ConOps driven
  - Near-term, interim solutions (i.e. < 1 year); thus, low-tech solutions are encouraged.
  - Rapid communications response time
  - Don’t sacrifice stealth



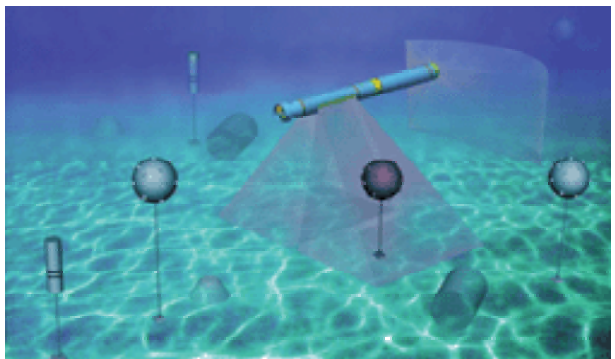
Capabilities Desired:

- “Toolbox” of capabilities, each tool suited to different operational / tactical situations. Criteria by which to CO decides which CatSD tool to use:
  - Submarine operating constraints (speed, depth)
  - Expendable vice retrievable (i.e. cost)
  - Stealth; covertness
  - Continuous vice intermittent connectivity
  - Data rate requirements
  - Comms range (i.e. LOS & acoustic options)
  - Need for bellringers / 1-way vice 2-way comms
- Technologies currently under consideration:
  - Expendable SATCOM buoys
  - Fields of acoustic nodes
  - Ship-to-ship acoustic comms
  - Towed buoy / floating wire systems
  - UAV relays, laser and RF
- Motivation for Near-Term (i.e. in 1 year) capability:
  - Training imperative for coordinated operations
  - To allow ConOps development
  - Interim capability should operational need arise

Offboard Vehicles / Sensors

Problem Description:

- Submarines need the ability to expand the extent of their influence through the use of offboard, unmanned vehicles, both UUVs and UAVs, and through deployable offboard sensors. Potential applications include:
  - ASW Cueing / Wide Area Search
  - ISR
  - Mine Warfare / Mine Countermeasures
  - Communications Relay
  - Environmental Data Collection
- Submarines need the ability to launch airborne weapons for shallow water self-defense against MPA, rotary wing, and swarms of small surface craft.



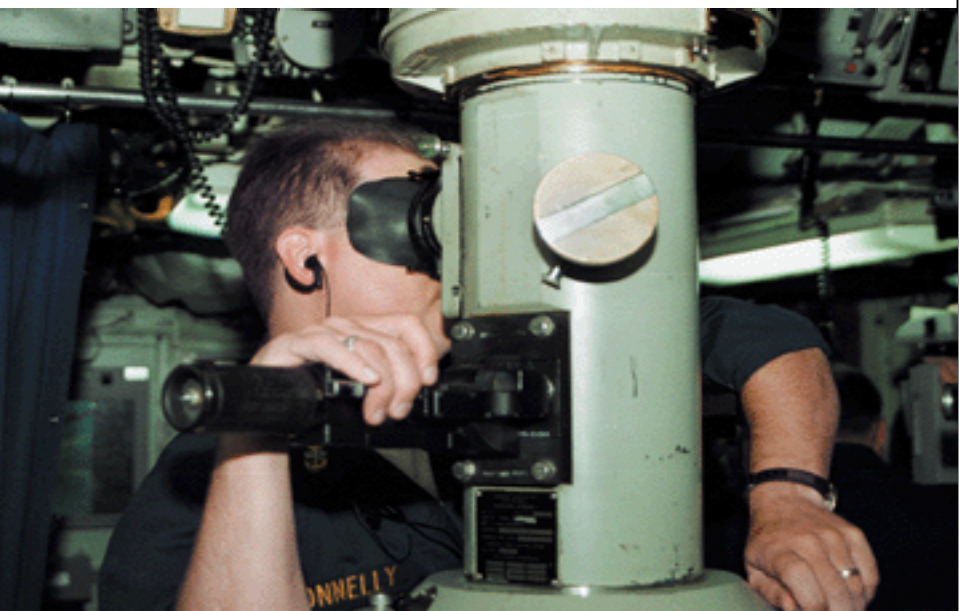
Capabilities Desired:

- Desired results:
  - More effective search rates
  - Use of UUVs for risky operations / areas
  - Expanded sensor coverage
  - Anti-air / small boat offensive capability
  - Better understanding of in-situ environment
- Challenges:
  - Affordable encapsulation (UAVs / self-defense)
  - Vehicle / sensor retrieval, when appropriate
  - Autonomous collision avoidance
  - Minimizing onboard footprint / support req’ts
  - Vehicle power management / power density
  - Maintaining communications with UUVs
  - Sensor miniaturization

Contact Management

Problem Description:

- Submarines need better tools to more safely and effectively operate in high contact density environments. Applications include:
  - Submerged collision avoidance
  - Coming to Periscope Depth
  - Contact management at Periscope Depth
  - Navigation
  - Contact classification



Capabilities Desired:

- Automated tools to conduct or assist with the fusion of contact data from different sensors:
  - Sonar
  - Visual (daylight and IR)
  - ESM
  - Radar (BPS-15 & Patriot)
- Help in coming to PD: Passive ranging system that yields range and bearing for typical surface contacts out to 5000 yds.
- Processing tools for periscope imagery:
  - Automated trackers / contact followers
  - 360-deg scene management
  - Automatic contact detectors
  - Bearing line indicators and range, course, speed as available (from sonar, radar, ESM)
  - Handoff of visual contacts to fire control
- Tools to aid with surface ship identification, classification, and targeting:
  - All weather, day/night capability
  - White shipping databases
  - Visual characteristics matching
- Tools to aid with safety of navigation at PD / surface
- Mechanisms to assess the accuracy of the solutions.

Joint & Cooperative Ops

Problem Description:

- Submarines need tools to seamlessly share tactical and operational situational awareness, and to improve sonar combat system effectiveness. Applications include:
  - Networked, cooperative ASW
  - Effective waterspace management
  - Data exchange with national, theater, and other off-hull systems to expand submarine situational awareness for ISR
- To complement the use of UUVs for mine warfare, submarines need better tools to conduct organic mine countermeasures.

Capabilities Desired:

- Common Undersea Picture (CUP)
- Common Operational Picture (COP)
- C4I that enables CUP and COP
- Systems that are Open Architecture (OA)
- COTS upgrades to sonar and combat systems
- TMA tactical decision and training aids
- Affordable hull mounted sensors having performance in the littoral comparable to that of a towed array.
- Improved active sonar capability and associated Tacaids
- On-board targeting capability for land attack, should that become the approach of choice
- Improved on-hull mine detection and bottom mapping through ARCI and BQS-15A software upgrades.
- Offensive capability against small boat swarms and low, slow flyers to deny access to the joint task force.


Questions
and
Discussion