

Application Session

Grand Challenge

- Imagine a devastating earthquake attacked a densely populated port city near the Arctic region which caused flooding, panic, humanity emergencies that can not be easily accessed by ground transportation. We need to send both manned and unmanned systems for rescue and supplies as first response and restore the functionality of the port. We need to make sure integrity of oil and gas pipes for energy supply, maintain communication links through underwater cables. Inspect integrity of structures underwater. We need to map out pollutions and contamination. We need to put continuous support of the recovery effort over a relatively long period of time in a matter of months or a year.

Who are customers? p1

- Oil and gas: Sensors and vehicles used in inspection of Structure health, gas pipelines under the ocean.
- National Security: Tsunami warning, earth quakes, Port Security, Submarine comm. Search and rescue,
- GPS underwater: Using acoustic network to guide moving things underwater either in a bay or across the ocean.
- Remote command and control for underwater environment.
- Oceanography: Seabed sensor fields, Polar Science
- Telecom companies who have trans-ocean cable systems.
- Education. Prepare future generation for underwater communication/Networking

Who are the Customers? p2

- Transportation: Navigation lanes inspection and maintenance. Improved blackboxes/tracking devices.
- Autonomous Shipping. Navigation in the Arctic.
- Environmental protection: Rivers and Lakes, Pollution monitoring and intervention
Sound pollution in sensitive places.
- Fishery management, Aquaculture.
- Diving (professional or recreational), Underwater Tourism, Underwater Habitat, Underwater Hotel
- Medical use of underwater communication technologies

Who are the Partners? p1

- Networking and communication researchers: optical, EM.
- Marine roboticist and underwater systems researchers: Smart floats, long endurance vehicles, Working class vehicles (Collaborative ROVs, Manipulators). Swarms of underwater vehicles. Manned ships or unmanned surface vehicles to command and collect data from underwater devices.
- Control and autonomy researchers who can pose needs and requirements for Acomm.
- Sensor network researchers: Long term underwater data collection.
- Oceanographers: GeoPhysical, Biological, Chemical.
- DoD/Government Labs.

Who are the Partners? p2

- Maritime Transportation Researchers
- Human Behaviors Researchers/Human-Autonomy A.I. researchers
- Ultrasonic Imaging Medical Researchers.
- Transducer designers. Material scientists.
- Environmentalists.

Where are the Gaps?

- Cost is too high, size is too big
- No consistency, no guarantee, no promise. Need performance curve instead of “up to”.
- No Yelp for acoustic modems. Mysterious appearance to be classified and restricted.
- Lack of user oriented simulation tools.
- Too many research papers with unrealistic assumptions, too few practical guides for the users. Lack of application driven papers that provide good use examples.
- Verification at sea and ocean are not easily accessible.
- Lack of continuous power supply and environmental energy harvesting.

What are the Promising Directions?

p1

- Software defined modems and networks.
- Build something the user can easily mess with. Better integration with carrying platforms. Reconfigurability and modularity.
- Miniaturizing hardware. More compact transducers or hydrophone arrays.
- Shared community testbeds, standards, platforms, simulation tools with user friendliness. Need continuous funding to sustain.
- Multidisciplinary research partnerships and projects: joint robotics/acomm projects, customize comm according to requests from partners and customers
- Low power technology under low temperature environment. Power management.

What are the Promising Directions?

p2

- Adaptive algorithms and behaviors that can cope with changing environment and unexpected events.
- Incorporating edge/cloud computing ideas into networking.
- Polar orbiting GPS satellites to help localize in the polar areas above water.
- Integrate swarming and autonomy research with realistic underwater communication constraints, intermittent localization, unreliable command and control.
- Biofouling and equipment maintenance in a relative permanent installation. Endurance and reliability research of materials in harsh environment

Who (else) Should Pay?

- NSF
- ONR
- DARPA
- DHS
- DTRA
- NASA
- NOAA/SeaGrant

Greener Grass

- Acoustics in air may benefit from us. Sound effect, music, speech etc.
- Extra-terrestrial ocean exploration.