2018 NSF Workshop on Underwater Wireless Infrastructure

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Washington DC, Nov 5, 2018

Sponsored by the NSF
Division of Computer and Network Systems

Topics and participants

- Four topics: Applications; Acoustic channel modeling; Implementation; Networks
- 27 participants

Lastname	Firstname	Affiliation
Singer	Andy	University of Illinois at Urbana Champaign
Zheng	Rosa	Lehigh University
Gendron	Paul	University of Massachusetts Dartmouth
Green	Dale	Teledyne (retired)
Melodia	Tommaso	Northeastern University
Deane	Grant	Scripps Institution of Oceanography
Zhang	Yanwu	MBARI
Smith	Ryan	Fort Lewis College
Sun	Zhi	University at Baffalo
Pan	Miao	University of Houston
Wang	Zhaohui	Michigan Tech
Chao	Yi	Seatrec Inc
Brown	David	UMass Dartmouth
Song	Aijun	University of Alabama
Zhang	Fumin	Georgia Institute of Technology
Hong	Xiaoyan	University of Alabama
Abdi	Ali	New Jersey Institute of Technology
Pompili	Dario	Rutgers University
Peng	Zheng	City Univ. of New York
Cheng	Wei	University of Washington Tacoma
Liu	Zhiqiang	Naval Research Laboratory
Tao	Qiuyang	Gorgia Tech
Emokpae	Lloyd	Naval Research Laboratory
Edwards	Catherine	University of Gorgia
Zuba	Michael	Raytheon BBN Technologies
Younis	Mohammed	University of Maryland Baltimore County
Lei	Hong	Portland State University

Program

- Program and presentations online:

http://uwa-cri.ua.edu

Workshop Agenda on Nov 5, 2018(one-day)

7:00 to 8:00: Breakfast/registration
8:00-8:10: Opening remarks
8:10 to 9:10: Applications
Fumin Zhang (Georgia Tech)
Yanwu Zhang (MBARI)
Ryan Smith (Fort Lewis College)

9:10 to 10:10: Network architecture
Tommaso Melodia (Northeastern University)
Miao Pan (Univ of Houston)
Zhaohui Wang (Michigan Tech)

10:10 to 10:20: Coffee break
10:20 to 11:20: Channel modeling
Grant Deane (Scripps)
Andy Singer (UIUC)
Paul Gendron (UMass)

11:20 to 12:20: Implementation-I
Rosa Zheng (Missouri University of Science and Technology)
Zhi Sun (University at Buffalo)
Yi Chao (Seatrec Inc)

12:20 to 13:00: Lunch
13:00 to 14:00: Implementation-II
David Brown (UMass)
Dale Green
Catherine Edwards (University of Georgia)

14:00 to 14:30: Coffee break
14:30 to 17:00: Breakout discussion
17:00 to 18:30: Summarizing discussions
18:30 to 20:30: Dinner + social hours
20:30 Adjourn

Applications: What are the Priorities?

- Shared infrastructure: Change the current mode that everyone needs to build or purchase their own robots or modems
  - Shared infrastructure should be installed and maintained by certain institutions
  - Shared access to an instrument pool
- Roles of the community infrastructure: Supporting research activities and proposals of the community members, future workforce development, outreach, and public engagements
- Key components of the shared infrastructure: Interweaving adaptive communications and networking with environmental sensing, feedback control, and AI planning
  - Multi-modal communications including underwater acoustic, MI, optical communications as well as in-air RF communications

Applications: Intellectual Challenges

- Integration of success of autonomy, communications, networking, localization, and navigation. Networked underwater autonomy is a great challenge.
- Repeatable experimental efforts motivated by the real scientific questions
  - In a controlled environments or real-life situations
  - Define a field campaign every year to verify integrated capabilities of autonomy and networks.
- Under-ice technology
  - Leverage access to the Great Lakes (seeking support from under-ice program at NSF, ONR, and NOAA)
- Underwater energy harvesting and wireless charging to support the integrated functionalities.
- Decision making for large number of intelligent assets leveraging shared information

Networks: Priorities

- Open-access infrastructure for underwater mobile networks
  - Support data collection, testing/demo, algorithm/protocol validation
- Benchmarks of simulations and experiment performances
  - A set of applications, locations of use, channel characteristics or channel catalog, hardware configurations, MAC/NET protocols, network size and architectures, etc.
- Network protocols for benchmark applications
- Standardization via benchmarking

Acoustic channel modeling: Projects

- Acoustic ranges: At least one open-access acoustic range for acoustic transmissions
  - Start with fixed node structure and standard transmission format, standard channel probes followed by a data payload
  - Design for directive transmissions and adaptive transmissions
  - Upgrade later to mobile nodes
- Suite of acoustic communications tools:
  - Standard channel models. Standard ocean waveguides. Replay of measurements. Documented and downloadable.
  - Physics-based model for understanding gross channel regimes for the standard channel models
  - Standard software modems to predict the performance of higher network functions
- Data repository: Establish best practices for packet generation and formatting
  - Limited access publication of existing datasets with metadata: SPACE08, RACE08, KAM08, KAM11

Implementation: Priorities

- Test facilities:
  - Reconfigurable ranges
  - Methods to share among the community users
  - Notes 1: Who might host a range? NSF craigslist for infrastructure
  - Notes 2: Obtain access to Navy assets for NSF use?
- Readily open digital boards/variable designs for acoustic front ends
- Repository for interesting data: searchable
- Establish a committee to identify ITAR and commerce regulations and find ways to rationalize some
- Standardize some modulation schemes: including transmitter design and simple receiver design

Proposals and funding outlets

- Proposal should be reviewed by reviewers from related underwater communities.
- A unified call for multidisciplinary underwater related proposals endorsed by different NSF programs (NSF Dear Colleague Letter).
- In large programs, try to organize more focused panels for underwater technology developments.
- Collaborate with the industry to bridge the valley of death. An open source shared infrastructure will help build up the bridge.
- Suggest ONR DRI or MURI topics. Multiple NSF CRI efforts. NSF MRI for some of the topics. NSF Mid-Scale Research Infrastructure is a possible venue.