

## Development of a Low-Cost Marine Mobile Networking Infrastructure

**U**nderwater acoustic communication has been in use for decades, but primarily for military applications. In recent years, private sectors such as environmental monitoring, off-shore oil and gas exploration, and aquaculture have become interested in its possibilities.

Existing research to understand underwater acoustic communication networks relies on human-operated surface ships or cost-prohibitive autonomous underwater vehicles (AUV). And due to the cost barrier, academic research evaluation is often limited to computer simulations, constraining research innovation and practical applications.

Recognizing a gap in the research, Zhaohui Wang and Nina Mahmoudian saw an opportunity to combine their areas of expertise: for Zhaohui, underwater acoustic communications, for Nina, low-cost marine robotics and AUVs.

With a \$50K Williams Seed Grant, the team took the research beneath the surface to develop a low-cost marine mobile infrastructure and investigate the challenges and possible solutions in engineering a leading-edge AUV communication network.

### They broke it down into three areas:

- Development of 2-3 low-cost, high-modularity autonomous surface vehicles (ASVs), each equipped with a collection of sensors and serving as surrogates for AUVs.
- Equipping each boat with an acoustic modem and implementing communication and networking protocols to facilitate underwater communication among the vessels.
- Conducting field experiments to collect data about the fundamental challenges in mobile acoustic communications and networking among the AUVs.

The team collaborated with scientists at Michigan Tech's Great Lakes Research Center, who reviewed their ideas and offered feedback, and provided research vessels to conduct field research on Lake Superior.

### The team's outcomes included:

- Two low-cost, autonomous, on-the-water boats, with the communication module below the water level;
- An experimental data set, data analysis, and preliminary results;
- A paper presented at the 2018 IEEE OES Autonomous Underwater Vehicle Symposium; and
- A marine mobile wireless networking infrastructure for use in continued research.

### What's next?

Just half of their seed grant has been used, and this summer Zhaohui and Nina will work to improve the boats and the communications system, and conduct more field research. In addition, they are planning to write two National Science Foundation proposals to take their research even further.



Zhaohui Wang

### The Researchers

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