µNet: Community-shared infrastructure for mobile underwater acoustic networks

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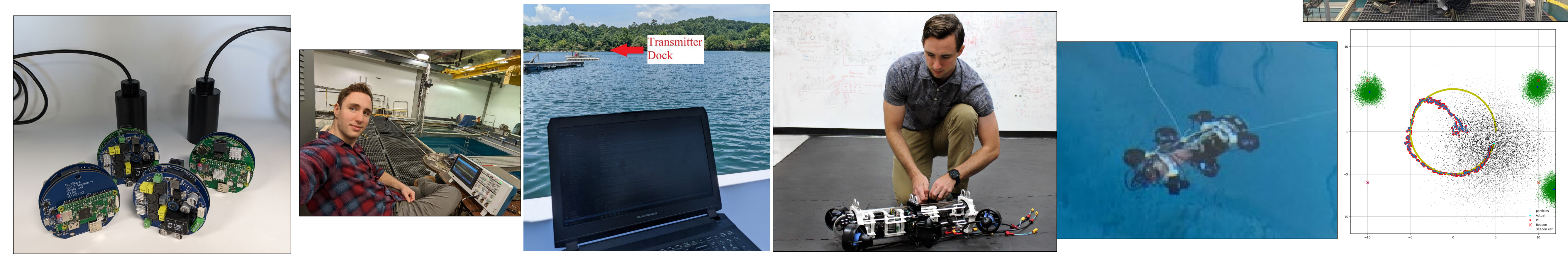**Electrical and Computer Engineering**
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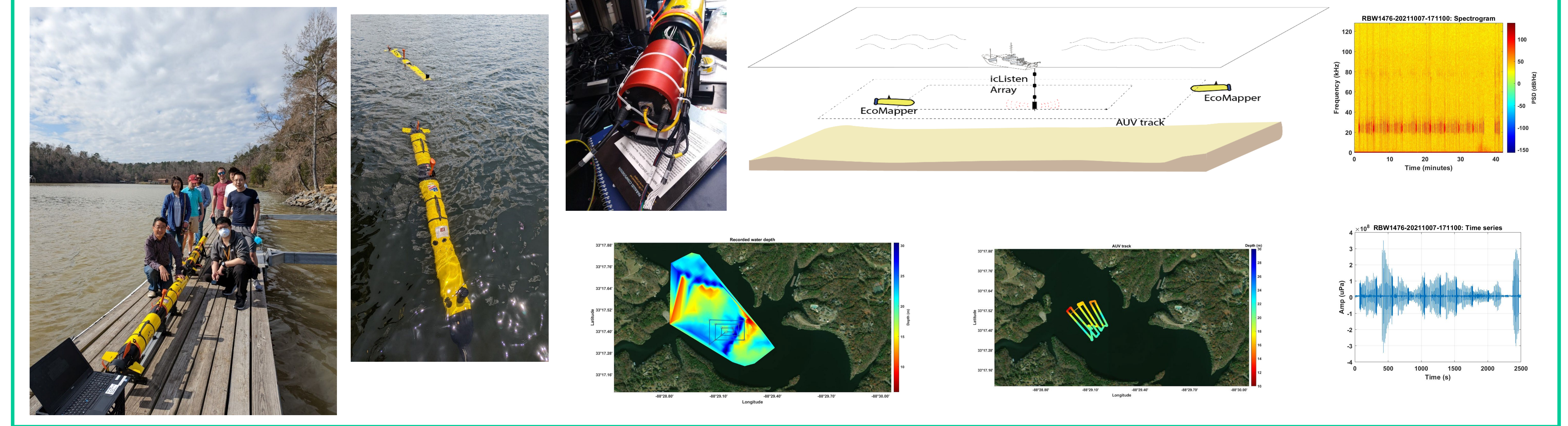**Computer Science**
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Abstract:
The aquatic environments, including the oceans, lakes, and rivers, are the basis for life. The next research frontier is to use fleets of aquatic robots to perform distributed sampling in aquatic environments. This project develops a community-shared, open-source, open-architecture infrastructure, µNet, for mobile underwater wireless networks. The infrastructure consists of 1) re-configurable software suites for simulations and emulation; 2) indoor testbed, miniaturized aquatic robots for lab tests; 3) lake testbed, commercial-off-the-shelf autonomous underwater vehicles (AUVs) for field tests, and 4) user services to support shared usage. The project goal is to establish an open ecosystem that can support research and education agendas across communities of acoustic communications, underwater networks, aquatic robotics, and data sciences.

Advancements have been made in the software development, indoor testbed, and lake testbed. Various modules have been developed for AquaNet, the core software, for simulation tools and software hardware integration. Acoustic modems and miniaturized aquatic robots have been designed and tested for the indoor testbed. The lake testbed has been developed and deployed. Multiple rounds of field experiments have been conducted.
Community engagement/outreach: Field measurements and related supporting tools have been distributed to early users. The PIs used various venues to promote infrastructure discussions. The investigators have been mentoring local school students for their robotics competitions.

Engagements: Workshops (WUWNet), D-camps

Acoustic modems

Reconfigurable software suite

ASVs & AUVs

Miniature robots

Resources & services
-Deployment/testbed service
-Data repositories
-Listserv/online forum
-Manuals, tutorials

Enabled research
Coordinated marine robotics
Underwater mobile networks
Joint networking & navigation
Underwater IoT

Outreach: Girls summer camps, summer schools, student underwater robotics competitions

AquaNet

AquaNet uses a service-oriented, non-hierarchical software architecture with a goal to support integrated sensing, communications, and navigation..
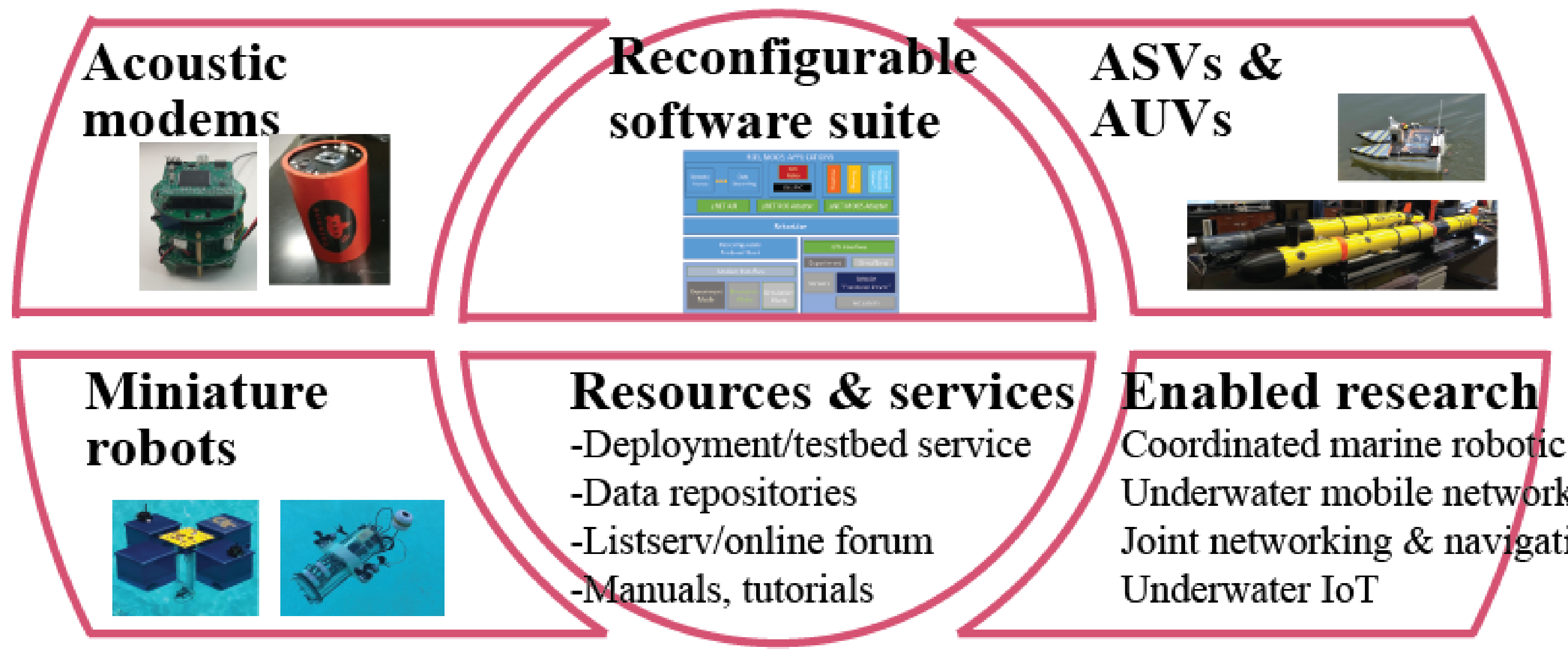

Indoor Testbed

The indoor testbed provides the community an open platform for underwater wireless communication, networking, and control in a lab setting. Open-source, low-cost BlueBuzz acoustic modems and miniaturized underwater robot (GT-MUR) have been designed and tested at Georgia Tech.

Lake Testbed

The lake testbed provides the community a shared infrastructure for field tests and data collection. Modem integration, software development, and validation tests have been completed at the University of Alabama. A series of field tests have been performed. Field measurements and tools have been distributed to early users.
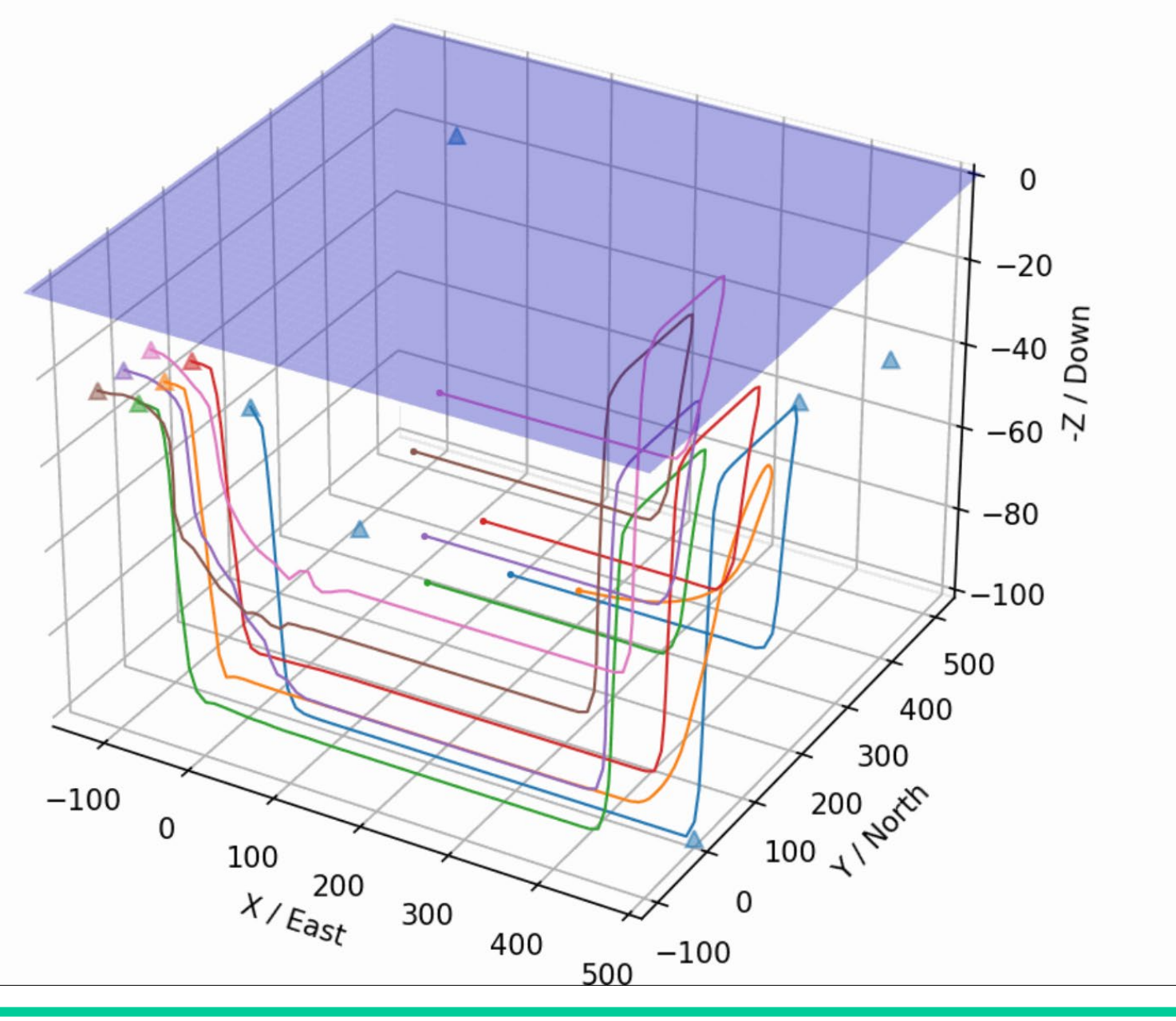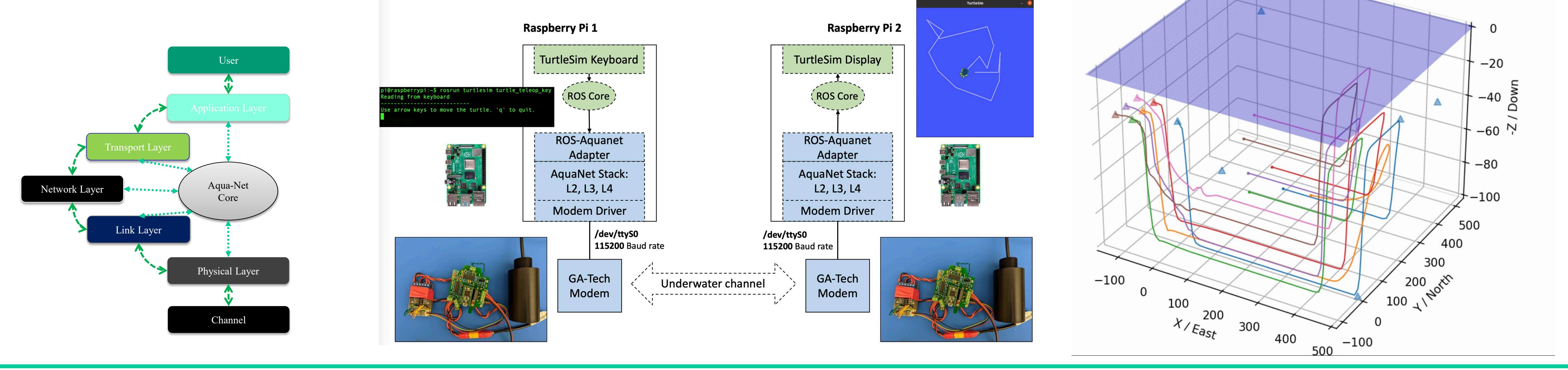

K-12 Outreach (mentoring high school robotics teams):

The µNet team mentors local high school robotics teams to design and build their unique underwater robots, namely remotely operated vehicles (ROVs). The robotics teams participated in regional ROV competitions in 2022 and 2023 and won multiple awards.
Other engagements: mini-workshops with users, organizing two special sessions at ASA meetings, invited talks at multiple different venues, and teaching graduate students to code in AquaNet.

Acknowledgement: