NRI: INT: Development of a Customizable Fleet of Autonomous Co-Robots for Advancing Aquaculture Production

NC STATE

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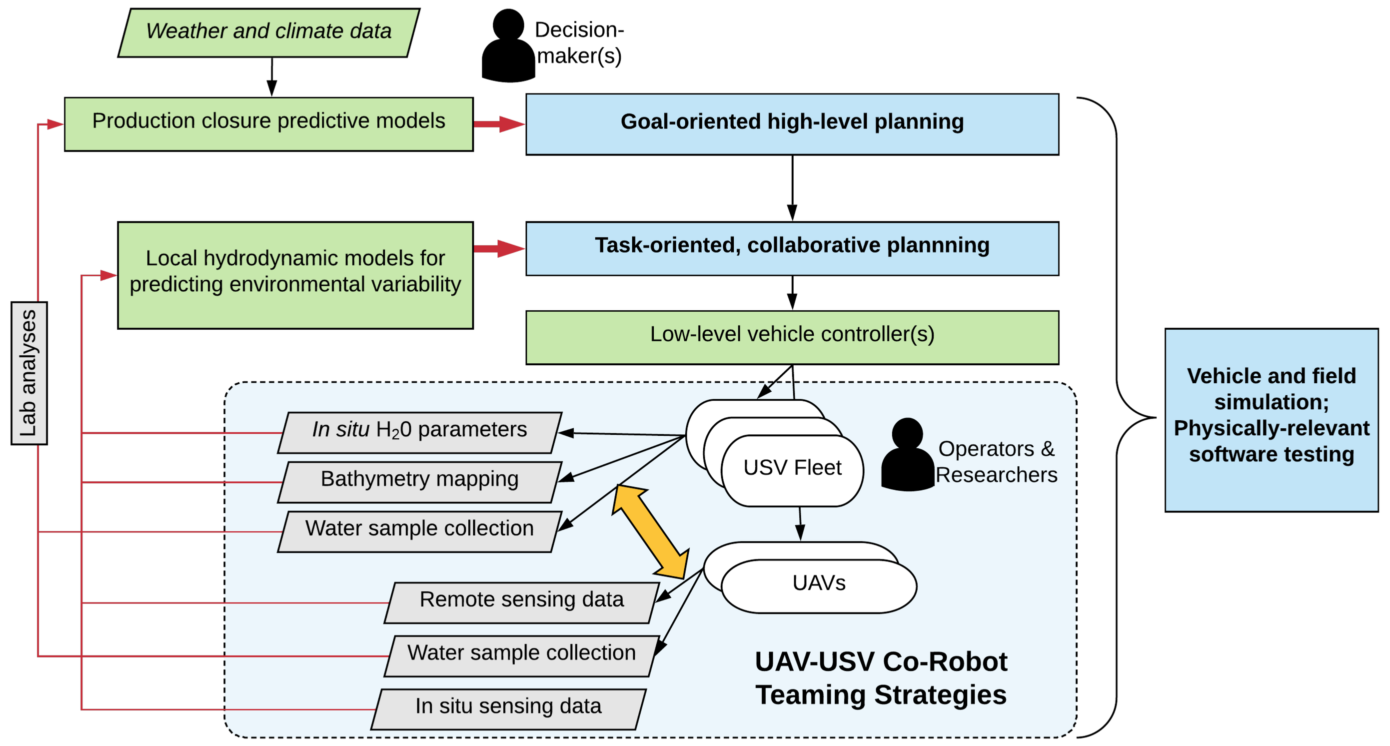
CO-ROBOTICS FOR AQUACULTURE.

Aquaculture is the fastest growing protein sector in the world, and an existing ≈$14 billion seafood deficit in the US is driving efforts to develop new, larger nearshore marine aquaculture systems to meet national demand. The aquaculture industry could embrace and pursue novel automated solutions centered around robotics to monitor production and sustainably increase yield while decreasing pressure on wild stocks.

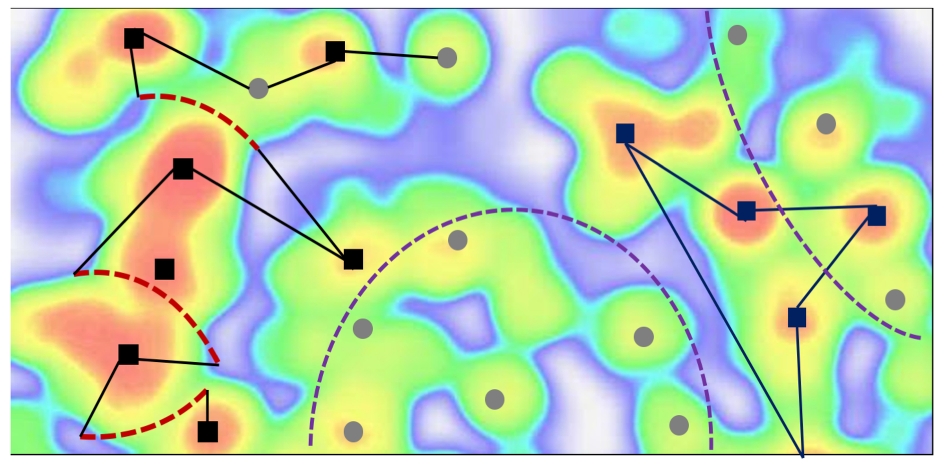
Water monitoring governs the opening and closing of production areas - such as oyster reefs - for food safety concerns are primarily dependent on water quality, and specifically the levels of fecal coliform in the water. These temporary closures on the East Coast negatively impact industry economics, and depending on their size, frequency, and timing, can cause more than 25% total revenue loss. Current sampling schemes result in severely biased and unusable water quality observations for statistical analyses and modeling. The inaccessibility of nearshore ocean environments makes it difficult to develop, test, and validate robotic systems.

This project will advance the *customizability* of UAVs and USVs for monitoring a variety of water properties in nearshore mariculture systems, with a case study on oyster production, through creating an adaptable, heterogeneous co-robotic fleet. This project will integrate hydrologic and hydrodynamic models of complex, dynamic nearshore coastal systems with task planning algorithms across multiple scales in a novel way for more optimal and information-rich monitoring, response, and exploration. Further, we will develop high-resolution physical simulations as a key enabling technology to accelerate robot system prototyping.



This work is important because it is one of the first focused efforts towards developing robotic systems for the near-shore aquaculture industry and will engage mariculture stakeholders from both government and industry throughout the project to better position them to adopt these systems. For researchers in this space, this project will lower the barriers to entry for mariculture robotics by creating and sharing digital tools, including simulation environments and software testing tools, to enable accelerated prototyping and development.

*It is necessary to **couple hydrodynamic predictive models with vehicle planning** to ensure important hydrodynamic processes are adequately captured and characterized during a mission.*



Possible mission where black squares represent USV sampling locations with red dotted lines that represent open boundary conditions for high-priority cells, navy squares represent UAV sampling locations, and gray circles inside the dotted boundaries represent monitoring targets for individual USVs.

We will utilize the NC Cooperative Extension to include stakeholders in testing and deployment and **engage with rural NC communities** during Extension field days, workshops, and conferences to showcase the new technology developed in this work. All PIs will be engaged with a targeted **workforce development** plan (Section 5) spanning across K-12, undergraduate, graduate, and community members to educate them on relevant aspects of marine robotics and aquaculture production.

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