2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

CPS: Medium: Enabling Real-time Dynamic Control and Adaptation of Networked Robots in Resource-constrained and Uncertain Environments

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Challenge:

- (Near) real-time water-quality monitoring of physical variables in rivers, lakes, water reservoirs is critical since contaminated water should not reach civilian population.

Solution:

- Designed a CPS where aerial drones and Autonomous Underwater Vehicles (AUVs) can identify in (near) real time Regions of Interest (RoIs) using adaptive sampling
- Engineered novel vision-based on-board Machine Learning (ML) processing algorithms for AUV robust navigation in murky waters
- Developed reliable and persistent data collection & transmission solutions to enable Underwater Internet of Things (UW-IoTs)
- Designed and Fabricated the new generation of the Rutgers Naviator (NV7), a multi-medium drone/UW vehicle

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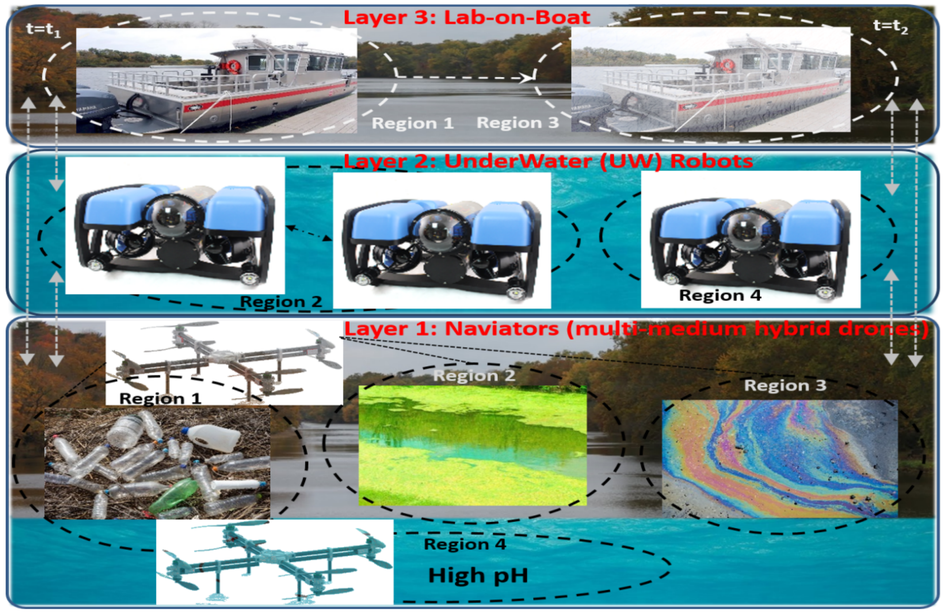

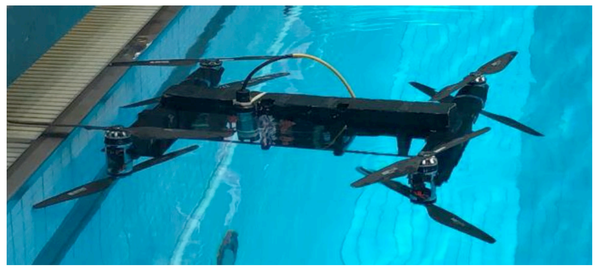

Scientific Impact:

- This CPS project generalizes to those cases where optimal decisions and timely closed-loop solutions should be deployed, or at least early warnings should be issued based on real-time, in-situ raw data processing

Broader Impact:

- The collaboration between cloud and local resources can benefit any CPS
- Outsourcing computation to the cloud will allow resource-constrained vehicles to meet mission deadlines
- The computational workflow tasks should be migrated from the local network to the cloud only when the former does not have enough computational resources to execute successfully the tasks (outbursting).
- This project has developed a pipeline of diverse computer literate engineers able to solve self-management CPS problems.