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

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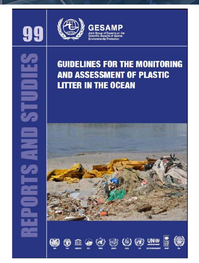
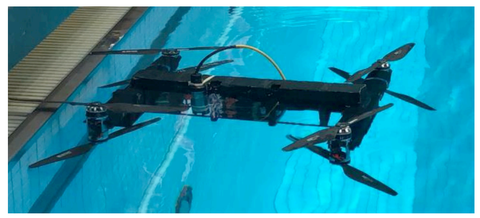
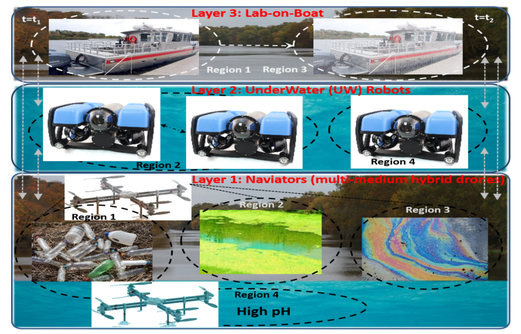
- **(Near) real-time water-quality monitoring of physical variables** in rivers, lakes, water reservoirs is critical since contaminated water should not reach civilian population.

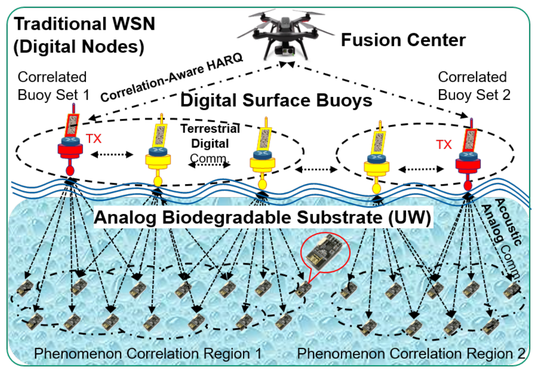


- **Optimal decisions and timely <u>closed-loop solutions</u>** should be deployed, or at least early warnings should be issued, so as to prevent damage to human and aquatic life.

- **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







- **Media Coverage and Impact of Project:**

[Undergraduate Publishes Research](): RU Engineer, *Rutgers Univ., SoE Newsletter*, vol. 4, no. 1, pp. 22-24, Fall 2019.

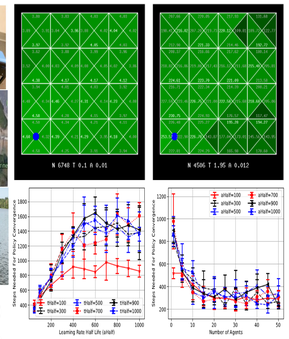
[Student Researchers from the Rutgers CPS Lab win 2019 IEEE Communications Society (ComSoc) Student Competition]():
- *Rutgers ECE News*, Dec. 2019.
- *IEEE Communications Society Newsletter*, Nov. 2019.

The Rutgers Raritan River Consortium (R3C) Mini-grant Award to support research on Raritan River, Basin and Bay Resource Issues, [Near-real-time Water-quality Monitoring in the Raritan River using a Hybrid Network of Autonomous Vehicles and Static Stations]()

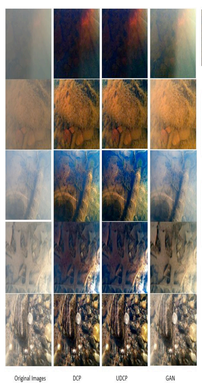
"Underwater, Networked Drones Monitoring Water Quality," The Environmental Monitor, March 6, 2018 [editor: K. Lant]

"Rutgers engineering team uses drones to check water quality in Raritan River," The Daily Targum, Feb. 8, 2018 [editor: J. Kim]

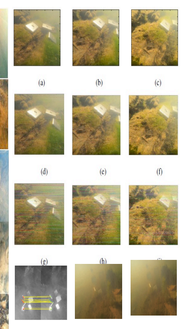
R1: (Top) Development of the vehicle; (middle) Heatmap displayed for the experiments; (Bottom) Test locations in the Raritan river, NJ and Marine park in Red Bank, NJ.



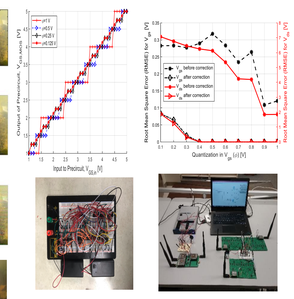
R2: (Top) MARL policy convergence; (Bottom) No. of steps needed for convergence vs. learning rate half time (aHalf) as Boltzmann temperature half life (tHalf) is varied.



R3: Image enhancement via Generative Adversarial Networks (GAN).

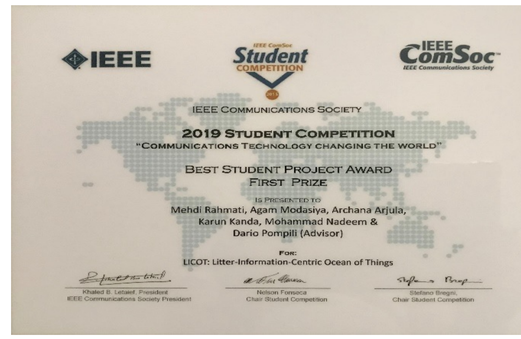


R4: (a)-(c) Frames from original video; (d)-(i) Reconstructed in vehicles with different channel qualities.



R5: (Top) Analog Joint Source Channel Coding (AJSCC) for two input voltages; (Bottom left) Proposed sensor prototype; (Bottom right) Demo of three transmitter in the air.

Finalist for the Best Paper Award of the ACM WUWNet'19
W. Chen, M. Rahmati, V. Sadhu, and D. Pompili, "[Real-time Image Enhancement for Vision-based Autonomous Underwater Vehicle Navigation in Murky Waters]()", in Proc. of International Conference on Underwater Networks & Systems (WUWNet), Atlanta, GA, Oct'19.



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