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Announces the Ph.D. Dissertation Defense of

William Fairman

for the degree of Doctor of Philosophy (Ph.D.)

Robotic Monitoring System for Complex Aquatic Environments

November 20th, 2025, 12:00pm – 1:30pm

Engineering East, Room: 405

777 Glades Road

Boca Raton, FL

Virtual Link: <https://fau-edu.zoom.us/my/wfairman>

DEPARTMENT: Electrical Engineering and Computer Science

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ABSTRACT OF DISSERTATION

Persistent monitoring in an aquatic environment is critical in many scientific and industrial applications. In-situ sensors that record water quality metrics, like dissolved oxygen, are essential in many aquaculture applications. Existing monitoring solutions can be cost prohibitive, difficult to maintain, and are typically deployed in fixed locations. This limits the usefulness of such systems in complex aquatic environments like coastal zones or pond aquaculture farms where bodies of water can be isolated from each other. In this dissertation research, an autonomous data collection framework is proposed to provide low-cost water quality monitoring through the combination of a variety of sensors and sensing platforms, such as waterproof UAVs and truck-based systems, that are optimized for in-situ sampling across disconnected bodies of water. Sensors and their platforms are connected to create an Internet of Things (IoT) sensor network for such environments. Sensor data collected from the system is transmitted and stored in a cloud database that provides users access to collected information via a web interface and text message alert system. To this end, this dissertation presents the methodology for designing optimal platforms, sensors, and their integration.

BIOGRAPHICAL SKETCH

Will Fairman was born in Miami, Florida. He earned his B.S. in Electrical and Computer Engineering from Olin College of Engineering in 2021 and joined Florida Atlantic University in 2022 to pursue a Ph.D. in Electrical Engineering. During his time at FAU, Will has worked as a graduate research assistant in the Systems and Imaging Lab (SAIL) at Harbor Branch Oceanographic Institute where he focused on developing water quality monitoring systems for aquaculture.

CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2022 – 2025



Qualifying Examination Passed: Spring 2023

Published Papers:

1. **W. Fairman**, P. S. Wills, D. Hanisak, and B. Ouyang, "Pseudorandom encoded-light for evaluating biomass (PEEB): a robust COTS macroalgal biomass sensor for the integrated multi-trophic aquaculture (IMTA) system," in Big Data IV: Learning, Analytics, and Applications, F. Ahmad, P. P. Markopoulos, and B. Ouyang, Eds., International Society for Optics and Photonics, vol. 12097, SPIE, 2022, 120970J. doi: 10.1117/12.2618773. [Online]. Available: <https://doi.org/10.1117/12.2618773>.
2. **W. Fairman**, P. S. Wills, D. Hanisak, A. Karim, S. Singh, and B. Ouyang, "Deployment of the Pseudorandom Encoded light for Evaluating Biomass (PEEB) sensor in an Integrated Multi-Trophic Aquaculture (IMTA) system," in Big Data V: Learning, Analytics, and Applications, P. P. Markopoulos, B. Ouyang, and V. Papalexakis, Eds., International Society for Optics and Photonics, vol. 12522, SPIE, 2023, p. 1 252 204. doi: 10.1117/12.2664101. [Online]. Available: <https://doi.org/10.1117/12.2664101>.
3. **W. Fairman**, P. S. Wills, L. Vila, and B. Ouyang, "Waterproof UAVs for sensing in coastal zones and estuaries," in Ocean Sensing and Monitoring XVI, W. Hou and L. J. Mullen, Eds., International Society for Optics and Photonics, vol. 13061, SPIE, 2024, p. 1 306 105. doi: 10.1117/12.3022720. [Online]. Available: <https://doi.org/10.1117/12.3022720>.
4. A. Davis, P. S. Wills, J. E. Garvey, **W. Fairman**, M. A. Karim, and B. Ouyang, "Developing and field testing path planning for robotic aquaculture water quality monitoring," Applied Sciences, vol. 13, no. 5, 2023, issn: 2076-3417. doi: 10.3390/app13052805. [Online]. Available: <https://www.mdpi.com/2076-3417/13/5/2805>.
5. Kunapinun, A., **Fairman, W.**, Wills, P. S., Hanisak, D., & Ouyang, B. (2024). Advancing Seaweed Cultivation: Integrating Physics Constraint in Machine Learning for Enhanced Biomass Forecasting in IMTA Systems. Remote Sensing, 16(23), 4418. <https://doi.org/10.3390/rs16234418>

Patents:

1. US Patent US12320731B2, Ouyang, Wills, **Fairman**, Den Ouden, Lopes, Platform-Independent Mobile Environmental Sensing System, PCT/US22/53371, June 3, 2025. Available: <https://patents.google.com/patent/US12320731B2/en>