Cleveland State University
College of Science

COLLOQUIUM

Matea Santiago

Postdoctoral Research Associate

Department of Mathematics

University of Arizona

Pulsing Xeniid Corals Modeling and Simulation: Mixing, Photosynthesis, and Muscle Contraction

Friday November 18th at 2:30pm in RT 1516

Bio: Matea is a postdoctoral research associate at the University of Arizona. She received her Ph.D. in Applied Mathematics at the University of California Merced. Her research focus is computational fluid dynamics, fluid-structure interactions, and concentration dynamics with moving source terms. Her work straddles the intersection between mathematics, physics, biology, and computer science. She is passionate about mentoring having supervised five undergraduate projects and mentoring a summer REU. Additionally, DEI work is central to her role as a researcher, educator, and mentor.

Abstract: Sessile Xeniid corals rhythmically pulse their tentacles by actively contracting their muscles. The behavior is unusual in that it doesn't seem to enhance feeding. Rather, experimental results have indicated that the pulsing facilitates the photosynthesis of their symbiotic algae by mixing the fluid to advect photosynthesis' waste, oxygen, away from the tentacles. This work seeks to use modeling and numerical simulation to understand this unique behavior using various methods and approaches. I will first discuss my thesis work which uses the classic immersed boundary method to numerically simulate the elastic coral tentacles' interaction with the surrounding fluid in two dimensions. The simulated velocity field is then used to find the Poincaré map, and the fluid mixing is quantified using the map's manifolds. I also coupled a photosynthesis model, where the tentacles act as an oxygen source. This project has progressed to fully three-dimensional simulations using IBAMR, an open-source, adaptive, parallelizable implementation of the immersed boundary finite element method. In this newer work, coral pulsing is driven by muscle contraction rather than prescribed motion, allowing for emergent behavior.

Refreshments will be served in RT 1517 at 2:10pm