Math Modeling of Fish Schools

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Research Focus: Dynamical systems theory with applications to marine systems, aquatic animals, underwater vehicles, and schooling behavior of social fish and their interaction with robots

Theoretical analysis:
- Schools modeled as graphs with fish as vertices and interactions among fish as directed edges
- Incorporation of numerosity, a relevant biological phenomenon, into graph structure
- Interaction networks constructed with numerosity facilitate consensus to mimic coordination of movement seen in schooling

A numerosity-constrained directed graph and regular directed lattice on 8 vertices with numerosity constant 2

Physical proximity and adherence to a common heading are used to assess the effect of different stimuli on live school. Leadership mechanisms are being studied to determine the characteristics of school leader and to implement these in the robotic fish.

Research in Classroom: Facilitate a robotics elective with middle school students at the Urban Assembly Institute of Math and Science for Young Women, an all-girls public school. Direct hands-on projects that illustrate basic physical concepts using student-friendly mechatronics platforms like the Basic Stamp 2 and the LEGO NXT robot. Lab exercises introduce students to sensors, computing, and empirical methods used in graduate research.

Planning a fun-science activity in collaboration with the New York Aquarium to introduce students to the basics of underwater locomotion. Using the swimming basics observed in live animals, students will have the opportunity to control robotic fish with a student-designed tail.

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