הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

Faculty of Mechanical Engineering הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Monday, July 13, 2026, at 11:45-12:15, Lady Davis Building, room 433

Experimental investigation of a planar three-link swimmer in viscous fluid

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Adviser: Prof. Yizhar Or

Locomotion of micrometer-sized swimmers is governed by low Reynolds number hydrodynamics, demanding non-reciprocal periodic shape changes for propulsion. While Purcell's planar three-link swimmer is a canonical theoretical model, validating its analytically derived optimal gaits experimentally remains challenging due to unmodeled real-world fluidic and mechanical complexities. To bridge this gap, we developed an improved design of the untethered, macro-scale robotic surrogate, operating in highly viscous silicone oil to emulate the Stokes regime. This experimental design was constructed as a physical realization of the theoretical model established in previous work of Oren Wiezel and Noam Berkovich Lahav, specifically the central rigid sphere he introduced to represent the added drag of the robot's central flotation block. This platform allows for precise control over the time dependent shape variables (joint values of the robot) that serve as the primary control inputs for the governing dynamic equations. To reconcile the real robot's physics, specifically the added drag of its central flotation unit, we utilize a modified theoretical formulation that incorporates a central spherical drag element. In our experiments, the robot was placed in a circular pool of silicone oil (large enough to neglect wall interference). Using a camera system, we tracked the robot's motion to validate the joint inputs and displacement, allowing comparison between analytical results and real-world data. By tracking our robot, we provide a physical demonstration of these large amplitude gaits. Our results provide an experimental validation of the "Geometric Analysis" framework and optimal control trajectories previously developed by Berkovich Lahav. Our results reveal that the relationship between stroke amplitude and phase is counter-intuitive; in some cases, shifting these variables even causes a reversal in the direction of movement.

Seminars Coordinator: Prof. Sefi Givli

Note: the seminar will be given in English