



MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, June 18 2026 at 13:30-14:00 Israel time (18:30-19:00 China time)

GTIT, North Campus, China

Online:

<https://technion.zoom.us/j/96972024622?pwd=V5efarI8FMeTDadAszeZWZ05v8P8so.1>

Data-driven Dynamics Modeling and Reinforcement Learning Control of Bionic Fish Robots

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Fish-like robots have advantages over traditional underwater vehicles in characteristics such as maneuverability, agility, and energy efficiency. However, the motion planning and control of fish-like robots are challenging due to the complexity of the fish's locomotion mechanics, the intricate three-dimensional fluid-structure interaction, system nonlinearity, the added-mass effect, and the underactuated dynamics system nature. In order to enable path planning, traditional methods rely on surrogate modeling, kinematics-based dynamic modeling, and CFD-simulation-based modeling, which are either of low fidelity or require massive computational power. While fish lack the theoretical knowledge of fluids or fluid-structure interaction simulations, they are master swimmers. Moreover, they learn all the skills by interacting with the environment. Inspired by this, we propose to use an artificial neural network (ANN) to directly fit the two-dimensional dynamics model of the fish-like robot and its interaction with the surrounding environment. The high fidelity of the ANN is validated by experiments and used as a simulation environment. Deep reinforcement learning, specifically, PPO (Proximal Policy Optimization), is used to train control policies, which can then be applied to fish-like robots in the real world for motion control tasks. Experimental results have validated the effectiveness of the data-driven dynamic model. The fish-like robot is capable of reaching preset goals with a positional accuracy of 0.018 m (0.075 body length) and an orientation tolerance of 0.128 radians, which validates its high-precision performance. The accuracy is much better than the surrogate-based modeling method. This is the first time that the fish-like robot learning and training process is automatic and does not require any expertise in CFD or dynamics. The new modeling method is validated by a fish-like robot but can also be potentially used to train other robotic systems of various shapes and form factors to achieve precise path planning and control.