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Fish locomotion: insights from both simple and complex mechanical models

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Fishes are well-known for their ability to swim and maneuver effectively in the water, and recent years have seen great progress in understanding the hydrodynamics of aquatic locomotion. But studying freely-swimming fishes is challenging due to difficulties in controlling fish behavior. Mechanical models of aquatic locomotion have many advantages over studying live animals, including the ability to manipulate and control individual structural or kinematic factors, easier measurement of forces and torques, and the ability to abstract complex animal designs into simpler components. Such simplifications, while not without their drawbacks, facilitate interpretation of how individual traits alter swimming performance and the discovery of underlying physical principles. In this presentation I will discuss the use of a variety of mechanical models for fish locomotion, ranging from simple flexing panels to complex biomimetic designs incorporating flexible, actively moved, fin rays on multiple fins. Mechanical devices have provided great insight into the dynamics of aquatic propulsion and, integrated with studies of locomotion in freely-swimming fishes, provide new insights into how fishes move through the water.