Center for Environmental & Applied Fluid Mechanics

"Unsteady Flow Physics in Bio-inspired Swimming: A Computational Study of Foil-Fish and Fish-Fish Interactions"

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Abstract: In this talk, we will introduce a computational approach that employs image-guided techniques to study the unsteady flow physics of live fish swimming. We utilize a high-speed, multi-camera system alongside a virtual scene kinematics reconstruction technique to measure the kinematics and flexibility of the fish's body and fins with remarkable detail. To simulate the corresponding unsteady flows in their full complexity, we apply a 3D incompressible Cartesian-grid-based immersed boundary flow solver in conjunction with a tree-topological local mesh refinement (TLMR) method. We will analyze the vortex dynamics resulting from interactions between the fish's body and fins, as well as interactions among the fins, including an examination of the hydrodynamic performance in both solitary and collective swimming. The findings from this research reveal various mechanisms that enhance performance, providing new insights into the design of highly efficient bio-inspired underwater robotic systems.

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