Probing the Links between Fluid Mechanics and Biology with Simulation-based Research: Recent Advances and Future Ventures

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Biological fluid mechanics (or biofluids) is the study of fluid flows in and around living organisms in order to elucidate and quantify presumed links between fluid mechanics and a particular biochemical process or specific behavioral and/or evolutionary patterns. Examples highlighting the diversity of this broad, cross-disciplinary area range from the interaction of fish and other aquatic organisms with turbulence in natural and engineered environments to the role that blood-vessel scale hemodynamics play in stimulating disease-inducing biochemical processes at the cellular level in the cardiovascular system.

Fotis Sotiropoulos is the James L. Record Professor of Civil Engineering, professor of Biomedical and Mechanical Engineering at the University of Minnesota, as well as the Director of the St. Anthony Falls Laboratory. His research is aimed at developing novel, high-resolution, fluid-structure interaction, computational fluid dynamics algorithms for enabling virtual experiments and simulation-based engineering design in real-life environmental, renewable energy, biological, and biomedical applications. Ongoing work focuses on: wind and hydrokinetic turbine flows; plankton and fish swimming in turbulent aquatic environments; medical devices and virtual surgery; stream and river restoration flows; sediment transport and bridge scour; buoyancy dominated flows; and chaotically advected flows.