Title of Project : Computational bio-propulsion of fishes

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Short Description

Aquatic animals have developed through long evolution various mechanisms for locomotion in their watery world. Aquatic propulsion presents a fascinating field of study in hydrodynamics that is both rich in its variety and subtle in its details. It is a generally held belief that evolution selection has conferred on animals a set of behaviour that is in some manner optimized for its survival. Fish-like swimming represents one important facet of aquatic propulsion. Experiments show that the typical fish propels itself forward through water by propagating a wave backwards along one or more flexible sections of its body. For fast swimming, the body and caudal/tail fin combination is usually the principal propulsor. For slow swimming, fishes may employ the median fins or pectoral fins. Manoeuvrability is a key factor of survival, especially in predator-prey encounters. The typical fish is also able to manoeuvre and turn in volumes with dimensions that are not much larger than total length and often at high speed.

Interest in aquatic propulsion is motivated by scientific curiosity as much as its potential exploitation in the design of novel propulsion systems as alternatives to the conventional propeller- or jet-based systems. Aquatic animals create minimal flow disturbances during their swim – this is important for certain specialized applications.

In this project we shall be studying the hydrodynamics of various modes of fish swimming. The study will involve the application and further development of a fluid-body coupled Navier-Stokes code that we have already developed for this research. The project will investigates some of the following aspects of fish swimming:

(1) Rapid fish manoeuvres such as C-turn and S-start in caudal fin propulsion
(2) Median fin and pectoral fin propulsion
(3) Dynamic control of fish swimming for navigation to objectives and tracking of moving targets.