JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Weekly CEAFM Seminar: Spring 2014

Date: **Friday, February 28, 2014**

Time: 11:00 AM

Location: Gilman # 50 (Marjorie M. Fisher Hall)

Speaker: **Dr. Kourosh Shoele** (JHU | MechE)

Title: ***"Fluid Interaction with Structures, from Fish Fins to Hydrokinetic Devices"***

Abstract

Studying the interaction between fluid and structure is a fundamental step in understanding the underpinnings of many engineering and physical phenomena, from energy harvesting to biolocomotion of insects, birds and fishes. The complex nature of these interactions makes the design of computational, experimental, and analytical techniques for modeling such problems challenging. Here I discuss new procedures, both in potential flow and viscous flow, for studying the interactions of a flexible structure with a flow. In particular, I will focus on two particular phenomena, the flow interaction with skeleton-reinforced fish fins and the extraction of ocean energy through wind and wave conversion devices. Fins of bony fishes are characterized by a skeleton-reinforced membrane with a soft collagen membrane strengthened by embedded flexible rays. The fish can control the rotational motion of each ray to gain a multi-degree of freedom over the fin motion and deformation. We have developed special fluid-structure interaction models to simulate the performance of a structurally idealized flexible fin at both potential and intermediate Reynolds number flow. The results illustrate that the fish's capacity to control the motion of each individual ray, as well as the anisotropic deformability of the fin, are essential to high propulsion performance. By drawing connections with a set of phenomena, we demonstrate that this structural design is a recurring feature in nature. The ocean offers numerous resources for renewable energies, from winds to waves, currents and tides. The harvesting of ocean energy is a relatively new and emerging research area. The multidisciplinary nature of problems involving renewable energies requires the integration between several key areas including fluid dynamics, mechanical design of energy conversion devices, structural analyses of conversion devices and control engineering to improve the power generation. I discuss my recent progresses in modelling, control and prediction of dynamic systems in energy conversion devices. In particular, the results illustrate the benefits of active controlling of a point absorber wave converter and an oscillatory water column (OWC) device.