Blood Pumps and Fish Mouths: Biological applications of fluid mechanics
Dr. Steven Day
Departments of Biomedical and Mechanical Engineering, Rochester Institute of Technology
Date: Thursday, September 29, 2016
Time: 9:30 – 10:20 AM
Location: 358 Willard Blg.
Coffee and donuts will be provided

Abstract:
There is tremendous potential for engineers to contribute to biology and also a wide range of biological problems that push the state-of-the-art in engineering analysis and design. My research uses experimental methods, particularly Particle Image Velocimetry (PIV) and Computational Fluid Dynamics to study a range of applied and biological flows. In this seminar, I’ll talk about two of these, implantable blood pumps and suction feeding fish. In addition to spanning the range between man-made and natural systems, these two also straddle the continuum between traditional engineering design and basic science.

A ventricular assist device (VAD) is a mechanical pump that aids, but does not replace, the native heart. All of the currently available pumps have limitations related to the damage that they cause to blood or mechanical design life. The flow of blood within the pump is three-dimensional, turbulent, and time varying, yet critical because it determines overall pump performance and potentially contributes to both red blood cell damage and blood clotting. The mechanical specifications are extreme because they must withstand 20 or more years of continuous operation with no maintenance. A pump with magnetic bearings offers the potential of eliminating damage and mechanical wear.

Most fish feed by suction feeding, rather than biting. A suction feeding fish generates a flow field external to its head that draws prey towards and into the mouth. This is a very fast event, typically lasting less than 40 msec. Our quantitative understanding of this common behavior has increased dramatically during the past decade and now includes the temporal and spatial patterns of velocity and pressure of water in front of the fish, accessible models to predict performance that can be used for comparative and predictive biological studies. I’ll present a brief survey of what’s known and unknown about this ubiquitous high performance fluid mechanical system, including numerical simulation and measurements of fish trained to feed within a laser sheet.

Biography
Steven Day is currently faculty in the Departments of Biomedical Engineering and Mechanical Engineering at the Rochester Institute of Technology. After completing a BS in Mechanical Engineering at the University of Virginia, Dr. Day attended the von Karman Institute for Fluid Dynamics in Belgium and graduated from the program in Experimental and Applied Fluid Mechanics. He returned to the University of Virginia and completed his PhD in Mechanical and Aerospace Engineering. Dr. Day’s research applies methods in experimental and computational fluid mechanics to a wide range of applied and biological flows. One research focus is on the development of a state-of-the-art implantable blood pumps, which initially focusing on experimental measurements of the pump performance and internal fluid dynamics, but recently includes the entire design process of magnetically levitated pumps. A second focus continues work from a Post-Doctoral collaboration involving the application of fluid dynamics analysis to suction feeding in fish. These collaborative efforts effectively cross the traditional boundaries between the basic, medical, and applied sciences.