Center for Fluid Mechanics, Division of Applied Mathematics
Fluids and Thermal Systems, School of Engineering
Joint Seminar Series

TUESDAY – NOVEMBER 6, 2012
3:00pm
Barus & Holley, Room 190

William Olbricht
School of Chemical and Biomolecular Engineering
Cornell University
Ithaca, NY

Fluid Mechanics of Pulsatile Flow in the Brain

We have used two-photon excited fluorescence (2PEF) microscopy to study time-dependent blood flow inside and outside cortical arterioles and capillaries of live, anesthetized rodents. The method provides sufficient spatial and temporal accuracy to determine velocity profiles as a function of heartbeat and respiration cycles. Detailed velocity measurements can also be made of the interstitial flow outside blood vessels in the surrounding brain parenchyma.

We have applied this method and supporting analysis to two problems. First, we have studied effects of hematocrit on blood flow in arterioles and capillaries of the brain cortex. Elevated hematocrits are typical in a variety of diseases characterized by an overproduction of blood cells. Animals with elevated hematocrit exhibit altered velocity profiles in arterioles and an unusually large number of "stalled" capillaries with little or no blood flow. These capillary stalls, which may start owing to altered hemodynamics, can persist for long times as a result of leukocyte and platelet adhesion inside the stalled vessels. Second, we have used 2PEF microscropy to examine effects of blood flow pulsatility on interstitial flow in the perivascular space immediately outside the blood vessel wall. Here, pulsatility can have a strong effect on interstitial flow, which can have important consequences for drug delivery methods that deliver fluid containing therapeutics directly into the brain parenchyma to treat neurological disorders.

Host: George Karniadakis (George_Karniadakis@brown.edu)