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"Fluid Dynamics in the Brain"

We use two-photon excited fluorescence microscopy to study fluid dynamics in the brain, both inside blood vessels and in the surrounding interstitium.

To study flow inside blood vessels, we turn the microscope into a velocimeter and measure red blood cell velocities inside arterioles, capillaries, and venules of anesthetized animals. The resolution is sufficient in space and time to construct detailed velocity profiles and to show how they depend on heartbeat and respiration. We use this method to study blood flow in polycythemia vera, a disease in which the hematocrit — the red cell volume fraction — becomes abnormally large. Results show that in this disease, a significant fraction of capillaries are intermittently stalled for times that vary from seconds to hours. Diminished cortical blood flow may be associated with cognitive decline exhibited by some patients with this disease.

We also use two-photon microscopy to study flow in the interstitial space of brain tissue associated with a drug delivery method called convective-enhanced delivery (CED). In CED, fluid that contains drugs or nanoparticle drug carriers is infused into the interstitium through a needle implanted in the brain. The effectiveness of CED relies on achieving high infusion rates while controlling the spatial and temporal distribution of infused material. Our results suggest that fluid transport during CED is enhanced in high conductivity perivascular spaces — regions immediately outside blood vessels. We use measurements of the motion of nanoparticles to identify perivascular spaces and to characterize their structure and dynamics.

**Required Graduate Student Seminar for ChE 5971**

Refreshments served before Seminar

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