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MRI for Microfluidics

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Historically, Magnetic Resonance Imaging (MRI) was first used to visualize physiological flows by exploiting a plethora of artifacts that degrade standard imaging protocols, and it has since evolved to incorporate fairly complex velocimetry protocols. Liquid state MRI provides various encoding methods for the non-invasive, tracer-free probing of internal flows, and obviates many of the difficulties with optical diagnostics. Several challenges remain, however, in terms of the spatial and temporal resolution of MRI. We focus here on increasing the spatial resolution of proton MRI methods employed in the elucidation of diffusion and liquid flow through complex interstitial spaces. The first part of the seminar focuses on the extraction of subvoxel anatomical information by solving an inverse diffusion problem while the second involves the study of pressure-driven flow through arrays of interconnected, multilayered microchannel networks. Carefully designed test-sections (phantoms) were fabricated for the systematic investigation of issues related to fluid physics and velocity reconstruction accuracy, and their probing with three MRI protocols is discussed here. We conclude by formulating model-based reconstruction methods which improve the spatial resolution and accuracy of MRI, and by highlighting exciting developments in the pursuit of bona fide real-time MRI.

About the speaker:

J. G. Georgiadis is the R.W. Kritzer Professor of Mechanical & Industrial Engineering at the University of Illinois at Urbana-Champaign. His research activities pertain to designing the 21st century microfabrication facility, developing novel water purification materials and processes, or improving medical diagnostics. Georgiadis is a co-PI of the NSF Science & Technology Center of Advanced Materials for Purification of Water with Systems (WaterCAMPWS) and participates in the NSF Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems (NanoCEMMS), both headquartered in the University of Illinois.