# Johns Hopkins University's Electrical and Computer Engineering Distinguished Lecture Fall 2017 Seminar Series

**Thursday, October 5, 2017**
**3:00 PM – Olin Hall, Room 305**
**Light-fare reception hosted by ECE after seminar **

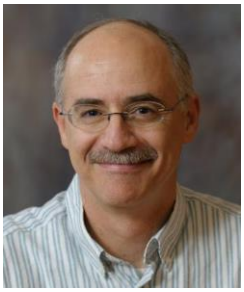
## "SAMPLING PATTERNS THAT EXPAND DATA DIMENSIONALITY FOR ENHANCED LABEL-FREE US PERFUSION IMAGING"


### Presented by Professor Michael Insana

*Department of Bioengineering, ECE, and Beckman Institute, University of Illinois at Urbana-Champaign*


Perfusion imaging methods provide essential clinical information for a broad range of diagnostic tasks. The low cost and safe use of ultrasonic methods make it an attractive modality for perfusion mapping. Contrast-agents are often necessary to separate weak blood echoes from surrounding tissue clutter, which raises new concerns about cost and safety. I will describe a method for echo sampling that enhances the sensitivity of US to slow-moving blood without contrast agents and without reducing the sensitivity to arterial flows.

To manage the concomitant increase in clutter and noise using our sampling strategy, we have adopted a higher-order singular-value decomposition (HOSVD) filtering technique that preserves the full dimensionality of the data



array. We validated our approach quantitatively via phantoms and functionally via an ischemic hindlimb mouse model and a melanoma tumor model. Using a 24 MHz linear array on the Visualsonics Vevo 2100 system, we acquired 2-D spatial frames in slow time at 1 KHz and at Doppler frame-time rates of 10 Hz. 4-D echo data arrays are reordered into 3-D arrays with one spatial dimension and two temporal dimensions. HOSVD decomposes this array into three orthonormal bases. The 3-D core tensor of singular values is then parsed into blood, clutter and noise subspaces and the power within each subspace is mapped into images. Applying our approach to the ischemic-hindlimb mouse model over a two week post-surgery period we tracked the revascularization process in a manner that was highly correlated with SPECT images describing tissue hypoxia and angiogenic responses. Results show perfusion sensitivity can be on par with contrast-enhanced power-Doppler images but at somewhat slower frame rates.

***Michael F. Insana*** *received his PhD in medical physics from the University of Wisconsin – Madison in 1983. He is currently Willett Professor of Engineering and a faculty member in the Departments Bioengineering and ECE at the University of Illinois at Urbana-Champaign. He also leads the Bioimaging Science and Technology group at the Beckman Institute on campus. He was the Head of the Department of Bioengineering in from 2008-2013 and again from 2017-2019. His research involves medical ultrasonic imaging as applied to cancer diagnosis and treatment monitoring. He develops instrumentation and methods for imaging soft tissue microstructure, viscoelasticity and blood flow. He develops task-based optimization methods for designing and evaluating sonographic systems. He has also developed novel methods for characterizing large-scale networks and other nonlinear systems. Michael is a Fellow of the IEEE, Acoustical Society of America, Institute of Physics, and American Institute of Medical and Biological Engineering. He currently is Editor in Chief of the IEEE Transaction on Medical Imaging, and co-chair of the 2016 and 2018 Gordon Conferences on Image Science.*

**Hosted by Prof. Muyinatu Bell**