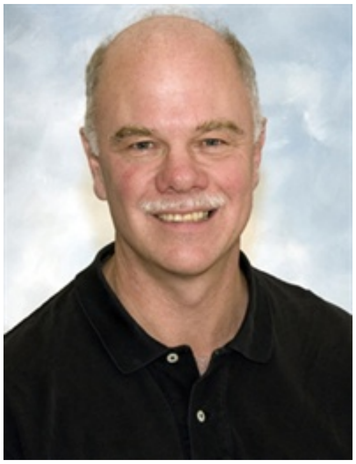

# JAMES S. DUNCAN


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Dr. Duncan is a Fellow of the Institute of Electrical and Electronic Engineers (IEEE), of the American Institute for Medical and Biological Engineering (AIMBE) and of the Medical Image Computing and Computer Assisted Intervention (MICCAI) Society. In 2012, he was elected to the *Council of Distinguished Investigators*, Academy of Radiology Research. In 2014 he was elected to the Connecticut Academy of Science & Engineering. He has served as co-Editor-in-Chief of *Medical Image Analysis*, and on the editorial boards of the *IEEE Transactions on Medical Imaging*, the *Journal of Mathematical Imaging and Vision* and the *Proceedings of the IEEE*. He is a past President of the *MICCAI Society* and in 2017 received the MICCAI Society's *Enduring Impact Award*.

## Left Ventricular Deformation Analysis from 4D Echocardiography: A Machine Learning Approach

### Oct. 19, Friday 2-3pm, Grover E 205


**Abstract:** Myocardial infarction (MI) remains a leading cause of morbidity and death in many countries. Acute MI causes regional dysfunction, which places remote areas of the heart at a mechanical disadvantage resulting in long term adverse left ventricular (LV) remodeling and complicating congestive heart failure (CHF). Echocardiography is a clinically established, cost-effective technique for detecting and characterizing coronary artery disease and myocardial injury by imaging the left ventricle (LV) of the heart. Our laboratory has been working on the development of an image analysis system to derive quantitative 4D (three spatial dimensions + time) echocardiographic (4DE) deformation measures (i.e. LV strain) for use in diagnosis and therapy planning. These measures can localize and quantify the extent and severity of LV myocardial injury and reveal ischemic regions.

In this talk, the image analysis system that combines displacement information from shape tracking of myocardial boundaries (derived from B-mode echocardiographic data) with mid-wall displacements from radio-frequency-based ultrasound speckle tracking to estimate myocardial strain will be discussed. The talk will first describe our earlier efforts based on Bayesian analysis and radial basis functions for integrating information. Next, a new robust approach for estimating improved dense displacement measures based on an innovative data-driven, deep feed-forward, neural network architecture that employs domain adaptation between data from labeled, carefully-constructed synthetic models of physiology and echocardiographic image formation (i.e. with ground truth), and data from unlabeled noisy *in vivo* porcine or human echocardiography (missing or very limited ground truth) will be described. Included in this will be discussion of our current strategy for LV surface segmentation via patch-based dictionary learning, our latest graph-based flow network ideas for surface shape tracking, early work on the use of Siamese neural networks for intensity-based patch matching and our very latest ideas on domain adaptation that include an autoencoder-based architecture. Test results on LV strain will be presented from synthetic and *in vivo* 4DE image sequence data, including a comparison to strains derived from MR tagging.