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The Department of Automatic Control & Systems Engineering
is pleased to announce the following seminar:

Biomedical Image Segmentation: Calculus of Variation vs. Deep Learning – A case study on the BRATS 2016 dataset

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Thursday, 27 July 2017 at 15:30
LT02, Sir Henry Stephenson Building

Abstract

Biomedical image analysis and segmentation is challenging because of the unpredictable appearance and shape of tumors from multi-modal imaging data. In this talk, we investigate two approaches: Mathematical modeling and optimization vs. deep learning; more specifically, partial differential equations vs. convolutional neural networks. Mathematically, we propose a deformable model based on the variational level set method (LSM) and non-negative matrix factorization (NMF). We describe the use of NMF, an algorithm based on decomposition by parts that can reduce the dimension of images from thousands of pixels to a handful of regions. Coupled with the variational framework, NMF-LSM is a powerful image segmentation method with pixel-level accuracy. In the second approach, we propose an automatic segmentation method based on Convolutional Neural Networks (CNNs) with a deep architecture. The two approaches are validated on the Multimodel Brain Tumor Segmentation Challenge (BRATS) 2016 database. We use the Dice Similarly coefficient and Haussdorff measure to assess the three tumor regions: whole tumor, core tumor and necrosis. NMF-LSM showed superior performance for whole tumor and necrosis in Hausdorff measure, whereas CNN showed superior performance for the tumor core in Dice metric. In our ongoing efforts, we are integrating both approaches towards a complete clinic-ready suite of MR analysis and display tools, named *coordinates and volumetrics for brain tumors*.

Biography

Dr. Nidhal Carla Bouaynaya received the B.S. degree in Electrical and Computer Engineering from the National School of Electrical Engineering, Computer Science and Telecommunications (ENSEA), France, in 2002, the M.S. degree in Electrical and Computer Engineering from the Illinois Institute of Technology, Chicago, IL, in 2002, the M.S. diploma (DEA) in Signal and Image Processing from ENSEA, France, in 2003, the M.S. degree in Mathematics and the Ph.D. degree in Electrical and Computer Engineering from the University of Illinois at Chicago, Chicago, IL, in 2007. From August 2007 till August 2013, she was an Assistant then Associate Professor with the Department of Systems Engineering at the University of Arkansas at Little Rock, Little Rock, USA. In September 2013, she joined the Department of Electrical and Computer Engineering at Rowan University, New Jersey, USA, where she is currently an Associate Professor. Her research interests are in signal, image and video processing, dynamical systems and machine learning. Dr. Bouaynaya won the Best Student Paper Award at SPIE Conference on Visual Communication and Image Processing (SPIE VCIP'06) in 2006, the Best Paper Award at the IEEE International Workshop on Genomic Signal Processing and Statistics in 2013 (GENSIPS'13) and the Runner-up Best Paper Award at the IEEE International Conference on Bioinformatics and Biomedicine in 2015 (BIBM'15). She is also the winner of the UALR Faculty Excellence Award in Research in 2013 and the 2017 winner of Rowan Excellence Award in Research. Her research is funded by the United States National Science Foundation (NSF), United States National Institutes of Health (NIH), New Jersey Department of Transportation (NJ DoT), United States Department of Agriculture (USDA) and the United States Federal Aviation Administration (FAA). She is also interested in entrepreneurial endeavors. In 2017, she Co-founded and is Chief Technology Officer (CTO) of MRIMATH, LLC, a start-up company in medical imaging.