KEYNOTE TALK
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Challenges and Opportunities for Extracting Cardiovascular Risk Biomarkers from non-contrast CT data

Ioannis A. Kakadiaris
Computational Biomedicine Lab
Depts. of CS, ECE, and Biomedical Engineering, U. of Houston

Abstract

In this talk, I will first offer a short overview of the research activities of the Computational Biomedicine Laboratory, University of Houston. Then, I will present our research in the area of biomedical image computing for the mining of information from cardiovascular imaging data for the detection of persons with a high likelihood of developing a heart attack in the near future (vulnerable patients). Specifically, I'll present methods for detection and segmentation of anatomical structures, and shape and motion estimation of dynamic organs. The left ventricle in non-invasive cardiac MRI data is extracted using a new multi-class, multi-feature fuzzy connectedness method and deformable models for shape and volume estimation. In non-invasive cardiac CT data, the thoracic fat is detected using a relaxed version of multi-class, multi-feature fuzzy connectedness method. Additionally, the calcified lesions in the coronary arteries are identified and quantified using a hierarchical supervised learning framework from the CT data. In non-invasive contrast-enhanced CT, the coronary arteries are detected using our tubular shape detection method for motion estimation and, possibly, for non-calcified lesion detection. In invasive IVUS imaging, our team has developed a unique IVUS acquisition protocol and novel signal/image analysis methods for the detection (for the first time in-vivo) of 'vasa vasorum' (VV). The VV are micro-vessels that are commonly present to feed the walls of larger vessels; however, recent clinical evidence has uncovered their tendency to proliferate around areas of inflammation, including the inflammation associated with vulnerable plaques. In summary, our work is focused on developing innovative computational tools to mine quantitative parameters from imaging data for early detection of asymptomatic cardiovascular patients. The expected impact of our work stems from the fact that sudden heart attack remains the number one cause of death in the US, and unpredicted heart attacks account for the majority of the $280 billion burden of cardiovascular diseases.

Speaker Bio-Sketch: Prof. Ioannis A. Kakadiaris is an Eckhard Pfeiffer Professor of Computer Science, Electrical & Computer Engineering, and Biomedical Engineering at the University of Houston. He joined UH in August 1997 after a postdoctoral fellowship at the University of Pennsylvania. Ioannis earned his B.Sc. in physics at the University of Athens in Greece, his M.Sc. in computer science from Northeastern University and his Ph. D. at the University of Pennsylvania. He is the founder of the Computational Biomedicine Lab (www.cbl.uh.edu) and in 2008 he directed the Methodist-University of Houston-Weill Cornell Medical College Institute for Biomedical Imaging Sciences (IBIS) (ibis.uh.edu). His research interests include cardiovascular informatics, biomedical image analysis, biometrics, computer vision, and pattern recognition. Dr. Kakadiaris is the recipient of a number of awards, including the NSF Early Career Development Award, Schlumberger Technical Foundation Award, UH Computer Science Research Excellence Award, UH Enron Teaching Excellence Award, and the James Muller Vulnerable Plaque Young Investigator Prize. His research has been featured on The Discovery Channel, National Public Radio, KPRC NBC News, KTRH ABC News, and KHOU CBS News.