

Cardiovascular Informatics: How to Stop a Heart Attack Before it Happens

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Abstract

In this talk, first I will 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 novel 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 also identified and quantified using a novel hierarchical supervised learning framework from the CT data. In non-invasive contrast-enhanced CT, the coronary arteries are detected using our novel 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 novel computational tools to mine quantitative parameters from the imaging data for early detection of asymptomatic cardiovascular patient. 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..