SEMINAR NOTICE

Department of Electrical and Systems Engineering

ELECTROCARDIOGRAPHIC CONSEQUENCES OF ELECTRICAL AND ANATOMICAL REMODELING IN DIABETIC AND OBESE HUMANS

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Abstract: Diabetes and obesity are two major risk factors for cardiovascular disease. Both can cause changes due to cardiac sources in body-surface potentials (BSPs), that is, in electrocardiograms (ECGs). By identifying the major effects of diabetes and obesity in BSPs, we hope to reveal the electrical phenotype of diabetes in body-surface ECGs in the presence of obesity. In our initial work, a bidomain platform was designed to link the heart-surface transmembrane potentials (TMPs) and BSPs. In the platform, a Forward-Problem Module was used to calculate BSPs from a bidomain-model of myocyte TMPs and torso anatomy. The platform also contains a Cardio-myocyte TMP Estimation Module in which an innovative method, named regularized waveform identification (RWI), was developed to reconstruct the TMPs from BSPs. Based on the bidomain platform, we characterized electrical changes with diabetes and anatomical changes with obesity; then independently evaluated their influences on BSPs. Simulation results showed that the RWI inverse solution performed much better than traditional regularization methods alone and is robust in the presence of noise and geometric error. By incorporating temporal information, in the form of the basic TMP wave shape, estimation accuracy was enhanced while maintaining computational simplicity. In addition, we recorded BSPs, heart and torso geometry from two adult male subjects: one normal and one obese diabetic. BSPs and estimated TMPs in these subjects, found by using the RWI method, were compared with the simulation results to identify ECG changes that might be found in the obese diabetic in a clinical setting. The results suggest that standard 12-lead ECG measurements could be strongly influenced by the anatomical changes associated with obesity. Body-surface maps and inverse solutions to the heart-surface that minimize volume-conductor effects are likely to be more useful in investigating the influence of diabetic electrical remodeling among obese diabetic patients. Furthermore, analysis of body surface potentials from an obese patient with diabetes indicated that dispersion of the QT interval reflected in the body surface potentials was more specific for the diabetic state than were other measures of the ECG.

DATE: Thursday, October 22, 2009
TIME: 10:00 a.m.
PLACE: Bryan Hall, Room 305

Dissertation advisor:
Dr. R. Martin Arthur

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