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Identify invariant patterns in ECG and respiratory waveforms with chaotic noisest

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Wearable technology and mobile platforms are becoming more and more popular in health care. Without interrupting users' daily life, we expect these sensors to work continuously for hours or days. In addition to the long working hours, we also design wearable sensors to have high data acquisition rate. For example, we use 1000 Hz for ECG sensor sampling frequency with each sample represented as 10 bits for transmission and 12 bits binary for storage. Instead of using distributed body sensors, we choose the integrated wearable ones. Use BioPatch as an example. It integrates ECG sensor, accelerometer, and temperature sensor onto one chip. This integration allows simplification of individual sensor design. Hence, by wearing one integrated wearable sensor node, we can measure heart rate, respiration rate, posture, activity and core temperature. However, with integrated sensor nodes, the Signal Noise Ratio (SNR) may change due to different levels of human activity under measurement. How to effectively identify ECG and respiratory patterns using raw data with chaotic noise and low SNR ratio becomes very challenging. In this talk, we introduce a new recognition method that uses chaotic theory to analyze and model ECG and respiratory data in real time. We transform the raw data into a phase space and match the limited amount of raw data to an optimal phase function. This phase function represents the pattern recognized. The trajectories of the identified patterns are going to be used to predict and reconstruct the delayed data points with upcoming activities. A real time simulation and model platform updates the patterns recognized in real time for both ECG and respiratory waveforms. Such a set of patterns together with high dimensional classification methods identifies chaotic noises without neglecting valid measurement of integrated sensors. We use data fusion algorithm to integrate information from multiple sensors to provide accurate real time feedbacks. In one application, we can use the heart variability (HRV) estimated using the proposed method to monitor patient stress level.

Biography

Janet Roveda received a BS degree in Computer Science from The East China Institute in 1991, MS, and PhD degrees in Electrical Engineering and Computer Sciences from the University of California, Berkeley in 1998 and 2000, respectively. She was a recipient of the NSF career award and the PEACASE award in 2005 and 2006, respectively. She received the best paper award in ISQED 2010 as well as best paper nominations in ASPDAC 2010, ICCAD 2007, and ISQED 2005. She is the recipient of the 2008 R. Newton Graduate Research Project Award from DAC, and the 2007 USS University of Arizona Outstanding Achievement Award. Her primary research interests focus on robust VLSI circuit design for data acquisition, biomedical instrument design, VLSI circuit modeling and analysis, and low power multi-core system design.

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