SHORT ABSTRACT

Electrocardiogram (ECG) signals are the manifestation of underlying electrical phenomena of heart, which are responsible for its various functionalities. ECG is used as an important non-invasive tool by the cardiologists to diagnose and assess a wide range of cardiac ailments. With advancements in wireless body area network (WBAN) technologies, significant research has been done in recent decades to develop low-cost personalized remote health monitoring systems for next-generation of e-healthcare solutions. With ever increasing number of cardiovascular patients, WBAN-enabled ECG telemonitoring has generated significant interest among the biomedical community. Ambulatory ECG enables remote monitoring of vital heart parameters and allows early medical interventions in case of life-threatening heart diseases. However, existing ECG monitoring systems still suffer from various challenges, such as limited autonomy, bulkiness, limited functionalities, etc. In recent years, compressed sensing (CS) has emerged as a promising framework to address these challenges. Low-complex and highly energy-efficient data reduction procedure of CS makes it an attractive choice over traditional wavelet-based techniques for embedded on-node ECG data compression in resource-constrained telemonitoring applications.

The main objective of the present dissertation is to explore the CS framework for multichannel ECG (MECG) signals. CS-based signal processing involves two operations: 1) CS encoding, where the data is linearly projected over a lower dimensional subspace using a sensing matrix to get the compressed measurements of the signal, 2) Signal reconstruction (decoding), where the original signal is reconstructed in a sparse domain using incomplete signal measurements. In the present thesis, there are three major contributions. First work focuses on efficient MECG signal encoding using an eigenspace CS approach. Second and third works contribute towards faithful signal reconstruction when low signal measurements are available at low data rates (or at high compression ratio).