**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**

**SHORT ABSTRACT OF THESIS**

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**SHORT ABSTRACT**

Electrocardiogram (ECG) is the most preferred non-invasive tool used by cardiologists to detect and diagnose various cardiovascular diseases. Electrodes, arranged in a specific order over the human torso are used for recording the signal. The lead signals acquired via these electrodes improves the spatial view of the heart. In other words, recording the signal with more electrodes improves the spatial resolution of ECG. The number of electrodes cannot be increased randomly as the comfort level of the patient is compromised, along with an increase in cost and complexity of the system. If fewer electrodes are used for recording, then the spatial resolution of the ECG is affected. A solution is to record ECG using fewer electrodes and use a system for enhancing the spatial resolution. Such systems are often recognized as the derived ECG systems and have many applications in personalized healthcare, telemonitoring, ambulatory monitoring, etc. The objective of this thesis is to derive the standard twelve-lead ECG from its subset without losing the diagnostic quality. Three approaches are proposed using various machine learning techniques for enhancing the spatial resolution of ECG. In the first approach, the inter-lead correlation in wavelet domain is utilized for deriving the standard twelve-lead ECG. This approach learns the model in wavelet domain using a linear transform and also selects the best predictor lead. The selection of predictor lead is performed by a lead selection algorithm which is based on a novel diagnostic similarity score. In the second approach, the dictionary learning and sparse domain framework is exploited in deriving the standard twelve-lead signals. A personalized dictionary is learned for transforming the ECG into sparse domain and a model is learned by mapping the sparse coefficients of predictor and response leads. This is then transformed back to obtain the derived signals. The importance of segmentation is also explored in improving the reconstruction accuracy of the derived signals. In the third approach, the intra-lead and inter-lead correlations in ECG is simultaneously exploited. This approach uses RNNs for learning the spatio-temporal correlations between lead signals. The capabilities of three different RNNs, simple RNN, long short-term memory (LSTM) network and gated recurrent unit (GRU), in enhancing the spatial resolution of ECG are investigated.