Abstract

MagnetoCardioGraphy (MCG), which is the magnetic counterpart of the surface ElectroCardioGraphy (ECG), measures the magnetic field (typically 50pT at QRS peak) produced by the electrical activity of the myocardial tissues constituting the heart in a non-invasive and non-contact way by harnessing the highly sensitive Superconducting QUantum Interference Devices (SQUIDs). The inherent advantages of the MCG technique have been explored in clinical research over the last two decades and is now receiving considerable attention. In view of this, several research groups, including that at IGCAR, Kalpakkam, have established multichannel MCG systems. These enable simultaneous measurements of magnetic fields at a discrete set of points on the thorax to generate a comprehensive picture of the magnetic field distribution, which makes it possible to visualize the cardiac source in terms of current density maps and source reconstruction through the solution of the inverse problem.

This thesis describes the efforts involved in the assembly and wiring of a multichannel MCG measurement facility and in using the facility to record multichannel MCG data. Since the measured MCG data often has a low signal-to-noise ratio (SNR), it was essential to explore methods to denoise the measured data prior to using for estimation of source parameters. Towards this, Ensemble Empirical Mode Decomposition (EEMD) based approach was developed and its performance in enhancing the SNR was assessed by comparing it with other standard denoising techniques based on wavelet transform and Independent Component Analysis (ICA). A combination of EEMD and ICA applied to the multichannel MCG data is shown to have the twin advantages of significant improvement in SNR and a lower computational burden. An assessment of the performance of the combination of EEMD and ICA has been compared with other standard techniques such as the use of ICA alone and wavelet enhanced ICA (wICA). The denoised data has been used for the construction of pseudocurrent density maps and for estimation of source parameters in the context of a single equivalent current dipole model. The effect of signal denoising on the pseudocurrent density maps and on the estimation of source parameters is discussed.