26th National Symposium on Cryogenics and Superconductivity

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Measurement of Magnetocardiogram in unshielded environment

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Content :

Measurement of the magnetic fields (~ 50 pico Tesla) associated with the electrical activity of the heart is termed as magnetocardiography (MCG). Owing to the fact that biomagnetic fields are orders of magnitude weaker than the earth's magnetic field and other electromagnetic interferences, their acquisition is confined inside a magnetically shielded room (MSR). Superconducting quantum interference devices (SQUID) which have unparalleled sensitivity down to a few femto Tesla, operating at 4.2 K liquid helium temperature are commonly employed to measure these weak signals (1-50 pico Tesla) with a clinically acceptable signal-to-noise ratio. However, it is not possible to accommodate any ac equipment inside the MSR since the equipment itself will generate magnetic field and hence it is difficult to record MCG in hospital environment. We have attempted measurement of MCG in unshielded practical environments using various signal denoising approaches like trigger locked averaging; adaptive filtering schemes, etc., to considerably improve the quality of the signals recorded. A site survey was conducted using flux gate magnetometer to find out residual magnetic field at various places around the lab and a relatively quiet place was chosen for the measurements.

A fiber reinforced plastic liquid helium cryostat comprising four Niobium based low Tc, DC biased SQUID sensors were used for the measurement. The cryostat was positioned above the chest surface to measure MCG signals. Power line interferences which are higher in magnitude than MCG signals have been effectively removed by employing a separate ECG channel given as a reference to adaptive filter and also using trigger locked averaging technique. The characteristic features of a typical cardiac cycle namely; P, QRS and T waveforms could be successfully retrieved from the noisy MCG using both the denoising schemes. The efforts are on to further improve the signal-to-noise ratio of the MCG signal which would exhibit least compromise in the quality of cardiac features with those measured inside a shielded room, such that the set up could be readily used in a hospital environment.

Keywords: Unshielded MCG, adaptive filters, SQUID sensors

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