Magnetocardiogram measurement using SQUID magnetometer and Magneto-Impedance sensor

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Magnetocardiogram (MCG) is useful for a clinical application and a health monitoring because it's possible to measure the heart activity without contact. In generally, MCG measurement was used a SQUID magnetometer. For daily health monitoring applications, MCG measurement devices need to be easy to handle. Specifically, it is highly desirable that operations in easy handing, without liquid helium and a magnetically shielded room (MSR). The SQUID magnetometer is high cost of equipment, high running cost due to the liquid helium and necessity of a MSR. On the other hand, A magneto- impedance (MI) sensor can use in room temperature and has a low noise level theoretically [1], [2]. Then we developed 64 channels MI sensor system for MCG measurement. We demonstrate MCG signals measured the SQUID magnetometer and the MI sensor.

MCG measurement for the SQUID magnetometer [3] was performed inside the MSR. The data among 150 trials were averaged for reduction noise. This averaged data is used as the reference signal, because it is high SNR MCG signal. MCG measurement for the MI sensor was performed outside the MSR. The minimum interval between the MI sensor and the chest wall of a normal subject was 5 mm. Noise rejection was carried out by time and spatial average using 64 position data. For time average, all magnetic data were averaged using among 300 trials at each position. For spatial average, 64 position data was compressed into 36 position data. As a result, MCG waveforms of 36 channels in Fig. 1 were obtained, and the QRS complex and T wave could be shown clearly. Compared to the reference signal measured with the SQUID magnetometer, similar characteristics were obtained for the signal measured with the MI sensor. The developed MI sensor system is effective in the health monitoring application.

This study was approved by the Ethics Committee of the Iwate Medical University (No. H22–147) and that of the Iwate University (No. 201704).

Reference

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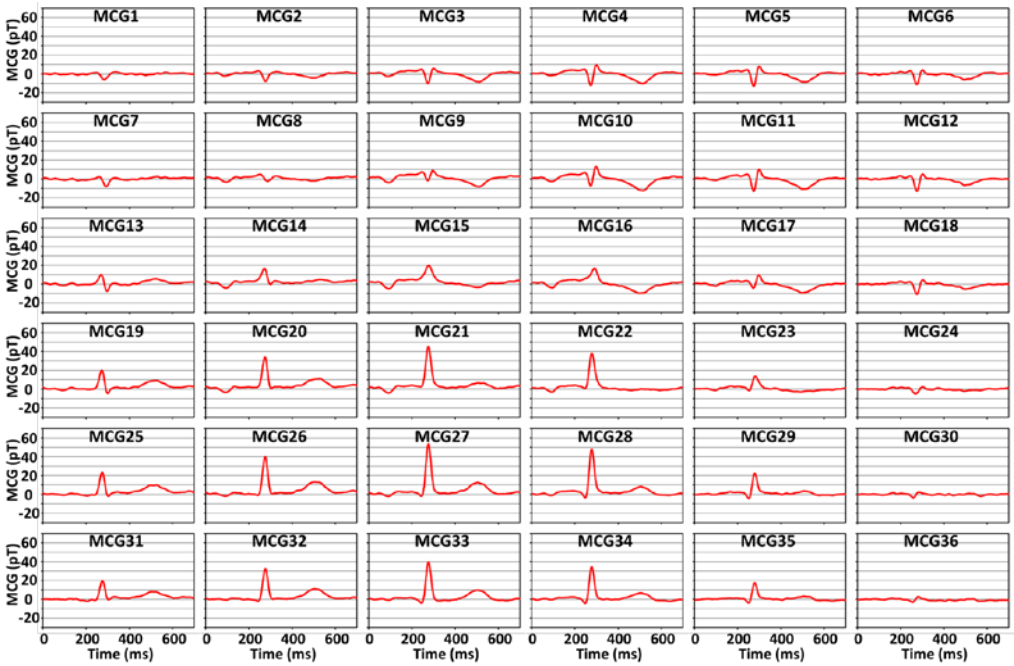

Fig.1 36ch MCG waveforms after time and spatial averaging.