Design of a SQUID Sensor Array Measuring the Tangential Field Components in Magnetocardiogram

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We consider design factors for a SQUID sensor array to construct a 52-channel magnetocardiogram (MCG) system measuring tangential components of the cardiac magnetic fields. Nowadays, full-size multichannel MCG systems, which cover the whole signal area of a heart, are developed to improve the clinical analysis with accuracy and to provide patients with comfort in the course of measurement. To design the full-size MCG system, we have to make a compromise between cost and performance. The cost is involved with the number of sensors, the number of the electronics, the size of a cooling dewar, the consumption of refrigerants for maintenance, and etc. The performance is the capability of covering the whole heart volume at once and of localizing current sources with a small error. In this study, we design the cost-effective arrangement of sensors for MCG by considering an adequate sensor interval and the confidence region of a tolerable localization error, which covers the heart. In order to fit the detector array on the cylindrical dewar economically, we removed the detectors that had been located at the corners of the array square. Through simulations using the confidence region method, we verified that our design of the detector array is enough to obtain whole information from the heart at a time. A result of the simulation also suggests that tangential-component MCG measurement can localize deeper current dipoles better than normal-component MCG measurement with the same confidence volume; therefore, we conclude that measurement of the tangential component is more suitable to an MCG system than measurement of the normal component.

keywords : magnetocardiogram (MCG), superconducting quantum interference device (SQUID), sampling theorem, confidence volume.