Influence of Sensor Noise on the Localization Error in Multichannel SQUID Gradiometer System

K. Kim*,[a], Y. H. Lee[a], H. Kwon[a], J. M. Kim[a], Y. S. Chung[a],
C. S. Kang[a,b], I. S. Kim[a], Y. K. Park[a], S. G. Lee[b]

[a] *Biomagnetism Research Center, Korea Research Institute of Standards and Science, Daejeon, Korea*

[b] *Department of Physics, Korea University, Jochiwon, Korea*

We analyzed a noise-sensitivity profile of a specific SQUID sensor system for the localization of brain activity. The location of a neuromagnetic current source is estimated from the recording of spatially distributed SQUID sensors. According to the specific arrangement of the sensors, each site in the source space has different sensitivity, that is, the difference in the lead field vectors. Conversely, channel noises on each sensor will give a different amount of the estimation error to each of the source sites. e.g., a distant source site from the sensor system has a small lead field vector in magnitude and low sensitivity. However, when we solve the inverse problem from the recorded sensor data, we use the inverse of the lead field vector that is rather large, which results in an overestimated noise power on the site. Especially, the spatial sensitivity profile of a gradiometer system is much more complex than a magnetometer system. This is one of the causes to make the solutions of inverse problems unstable on intervening of the sensor noise. In this study, in order to improve the localization accuracy, we calculated the noise-sensitivity profile of our 40-channel planar SQUID gradiometer system, and applied it as a normalization weight factor to the source localization using synthetic aperture magnetometry.

keywords : magnetoencephalography (MEG), superconducting quantum interference device (SQUID), synthetic aperture magnetometry (SAM), inverse problem, neuromagnetic source localization