The Effect of Statistically Constrained Minimum Mean Square Estimation Algorithm Which is Used For Human Head Tissue Conductivity Estimation to Source Localization

Sengul, G (Sengul, Gokhan)[1]; Baysal, U (Baysal, Ugur)[2]

Abstract

Determining the electrical active regions of human brain by using EEG and/or MEG data is known as "EEG/MEG bioelectromagnetic inverse problem" or "source localization". A typical source localization system intakes not only EEG/MEG data but also geometry information of subject/patient, a priori information about the electrically active sources, the number and 3-D positions of measurement electrodes and conductivities/resistivities of the tissues in the head model. In this study we investigated the conductivity estimation performance previously proposed Statistically Constrainted Minimum Mean Square Error Estimation (MiMSEE) algorithm by simulation studies and we also investigated the effect of the estimation to source localization activities. In simulation studies we used a three-layered (composed of scalp, skull and brain regions) realistic head model to estimate 100 different conductivity distributions in vivo. As a result we found that the proposed algorithm estimates the conductivity of scalp with an average error of 23%, the conductivity of skull with an average error of 40% and finally the conductivity of brain with an average error of 17%. In the second part of the study we compared the source localization errors for two cases: one, when the average conductivities of tissues given in the literature are used, and second when the subject-specific conductivity estimation is performed with MiMSEE algorithm. The results showed 10.1 mm localization error is obtained when the average conductivities given in the literature are used and 2.7 mm localization is obtained when subject-specific conductivity estimation is performed with MiMSEE algorithm. The results shows that the localization error is reduced by 73.07% when subject-specific conductivity estimation is performed with MiMSEE algorithm. We conclude that using the conductivities obtained from MiMSEE algorithm reduces the source localization error and we recommend to perform subject-specific conductivity estimation for source localization applications.