INFLUENCE OF AIR CAVITIES OF THE SKULL ON EEG SOURCE LOCALIZATION

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Abstract

We investigated the effect of omitting the air cavities of the skull due to using a simplified model of the skull instead of a more realistic one (reference) in the dipole estimation. Our results showed that more than 95% of the localization errors made by the omission of the air cavities were below 3 mm.

Keyword(s): medical imaging

1 Introduction

One of the main difficulties in electroencephalogram (EEG) source localization is the generation of a model that can accurately represent the human head. In this model, the *skull* is a crucial part due to its low conductivity and layered structure, which consists of spongy and compact bones as well as air–filled cavities. To our knowledge, the influence of the air cavities of the skull on EEG source localization has not been investigated in literature. Therefore, the aim of this work is to study the effect of omitting these cavities on the dipole source estimation.

2 Methods

A reference head model was constructed from magnetic resonance (MR) and computed tomography (CT) images with seven different tissues as shown in Table 1 [1].

To analyze the effect of omitting the air cavities of the skull in the dipole estimation, two simplifications from the reference model were made: (i) **Model 1** – air as compact bone and (ii) **Model 2** – air as spongy bone.

Tissue	Conductivity (S/m)
Scalp	0.33
Compact bone	0.0064
Spongy bone	0.02865
Air cavities	0.00
Fluid	1.79
White Matter	0.14
Gray Matter	0.33

Table 1. Conductivities of the reference model.

We investigated the dipole localization (DLE) and orientation (DOE) errors due to using a simplified model in the dipole estimation through the simulation setup of Fig. 1. A total of 8528 test dipoles was placed on a 5 mm 3D grid in the gray matter. The forward problem was solved using the Anisotropic Finite Differences with Reciprocity Method (AFDRM) [2]. From the simulated potentials at 27 electrodes, the dipoles were estimated by solving the inverse problem using model *i* (i = 1,2).

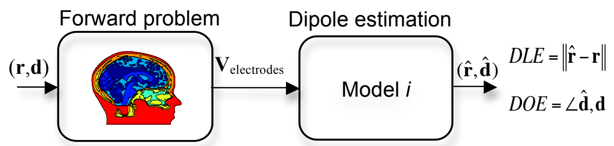

Fig.1. Simulation setup

3 Results

Fig. 2 shows the cumulative histograms of the DLE and DOE for models 1 and 2. The errors are overall lower for model 1. However, for both models more than 95% of the DLEs and DOEs are below 3 mm and 10º, respectively.

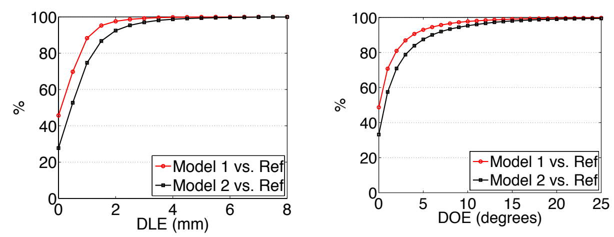

Fig. 2. Cumulative histograms of DLE and DOE.

4 Conclusions

The air cavities of the skull showed to have little influence on the dipole estimation (<5 mm) and to be better modeled as compact bone. Errors were larger in the frontal and basal regions of the brain due to the vicinity with the air cavities.

References

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