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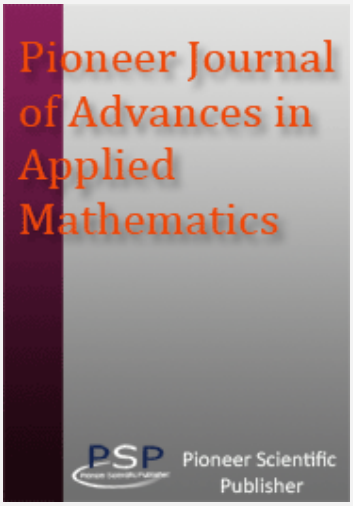

REVISITING A NUMERICAL IMPLEMENTATION OF THE EEG PROBLEM IN ELLIPSOIDAL GEOMETRY

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Abstract

A triaxial ellipsoid provides an approximation of the average human brain which is much better than the broadly used spherical model. The analytical solution of the forward problem of the Electroencephalography (EEG) with an isolated dipolar source has been already derived and reported in the literature. This solution is expressed in terms of an eigenexpansion in ellipsoidal harmonics. Nevertheless, this expression was not possible to be handled effectively since no ellipsoidal harmonics of degree higher than seven were available in closed forms. In order to analyze further this problem an effective numerical algorithm has been developed, which generates the ellipsoidal harmonics of arbitrary degree and order in a numerical form. The algorithm has been compared with the known analytical eigenfunctions and the results manifested a perfect coincidence. Finally, this algorithm was used to construct a numerically stable solution of the electric potential on the surface of the head, which is generated by a single dipole of arbitrary position and orientation. The degree of ellipsoidal harmonics needed for a numerically convergent solution goes all the way up to 30 and the result provides a slightly improved model for tackling boundary value problems in ellipsoidal geometry.

Keywords and phrases: electroencephalography (EEG), ellipsoidal coordinates, Lamé functions, ellipsoidal harmonics.