Simulations of local field potentials and Current Source Density analysis in slices with realistic conductivity distribution

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To test methods of local field potential (LFP) analysis we need realistic ground truth data which demands plausible models of neural activity and of physical properties of the setup, tissue, and the electrodes. To interpret the recordings we often reconstruct the Current Source Density (CSD) from the LFP. In this work we study the effect of realistic conductivity profiles and the slice geometry on i) computation of LFP generated by cell populations embedded in slice, as would be measured on multi-electrode array (MEA), and ii) current source density (CSD) reconstruction in the slice from such potentials. We show that the method of images approximates solution through finite elements well while being much more efficient computationally. Inclusion of slice properties with homogeneous and uniform conductivity in the slice noticeably modifies the observed activity (LFP) but inhomogeneity and anisotropy do not further change the profile and amplitude of the LFP.

Supported with grants: IP2011 030971, N N303 542839, FP7-PEOPLE-2010-ITN 264872, POIG.02.03.00-00-018/08, POIG.02.03.00-00-003/09