Magnetic Source MRI Without BOLD Signal Contamination

(1R01EB004753-01-FY04)
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The most widely used functional magnetic resonance imaging (fMRI) brain mapping technique is based on blood oxygen level dependent (BOLD) contrast between activated and non-activated tissues. As BOLD fMRI depends upon cerebral hemodynamics, its registration of neural activity has both temporal and spatial limitations. In contrast to BOLD, magnetic source MRI (msMRI) is based on enhanced field inhomogeneity caused by activation-induced changes in neuronal magnetic fields. It is a direct indicator of and is synchronized with neuronal firing. Therefore, functional brain maps generated by msMRI have higher temporal resolution and spatial accuracy than those generated by BOLD-based fMRI, as shown in our prior msMRI study. However, in our earlier work, the msMRI signal was measured in a steady-state background of BOLD signal. Here, we present a time-locked data acquisition and analysis strategy in which the BOLD signal has enough time to decay so that no or little BOLD contamination is included in the msMRI results. By effectively removing potential BOLD contaminations, we demonstrate that msMRI signals can be reliably measured with T_2^* pulse sequences, and the magnitude of msMRI signal changes is approximately 1%. Compared with event-related BOLD fMRI activation maps, activations in msMRI provide direct spatial maps of the underlying neuronal activities; they are also concomitant with neuronal activities temporally.

Publications

J. Gao, Q Luo, D Glahn, P Fox, J Xiong, Z Lu. Magnetic source MRI without BOLD signal contamination, submitted (2005).

Y Xue, J Gao, J Xiong. Direct MRI detection of neuronal magnetic fields in the brain: Theoretical modeling, submitted (2005)