fMRI at 7T: Whole Brain Coverage And Signal Advantages Even Infratentorially?

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Introduction: fMRI is one of the most likely applications to benefit from high field MRI. It not only profits from higher SNR, but also from increased BOLD contrast itself. However, this sensitivity to susceptibility also causes problems, e.g. in-plane dephasing and signal dropouts near tissue-air-boundaries. Therefore, most fMRI studies at 7T focus on high resolution in supratentorial areas.

Methods: 5 volunteers underwent an fMRI measurement at 1.5 T and 7 T (Sonata and Magnetom 7 T, Siemens, Erlangen, Germany with standard head coil) using a motor paradigma (finger-tapping) in a block design fashion. A BOLD-EPI sequence with short TE (30 ms) was chosen, covering the whole brain with 30 slices (thickness 3 mm, gap 0.3 mm) at 7 T, for the measurements at 1.5 T TE was 45 ms. A CP transmit/receive head coil (Invivo Diagnostic Imaging Corp., Gainesville, FL) was used for image acquisition. Statistical analyses were carried out using SPM 02 software.

Results and Discussion: All cerebral areas involved in finger tapping could be revealed at 7 T: cortical sensory-motor areas (SI, SII, SMA), thalamus, and contralateral cerebellar areas involved in sensory-motor processing (Fig. 1). At 1.5 T, thalamic activation was not detectable in three subjects. Furthermore, the signal change was significantly higher (two to threefold) at 7 T compared to 1.5 T. A reasonable response could be detected in all sensory-motor areas at 7 T, even in areas suffering from susceptibility effects like the cerebellum (Fig. 2).

Conclusion: Supra- and infratentorial sensory-motor areas can be reliably detected at 7 T using whole-brain fMRI, with good response functions and, as expected, higher signal compared to 1.5 T.

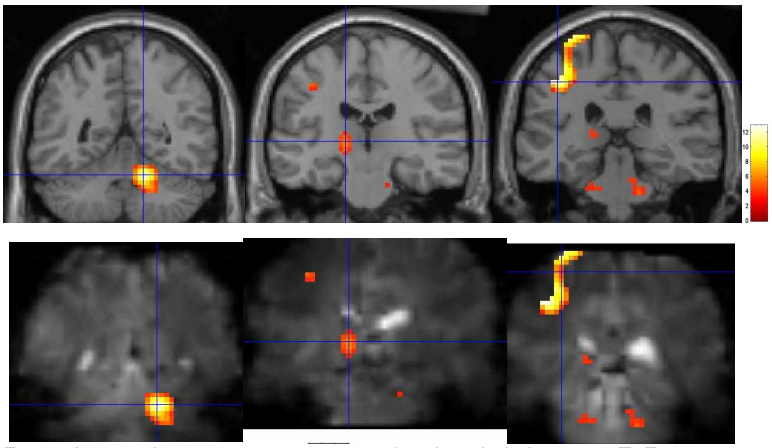

Fig. 1: Activated sensory-motor areas within the whole brain at 7T. First row: superimposed activation on a T1w standard brain. Second row: Activation superimposed on the individual EPI images.

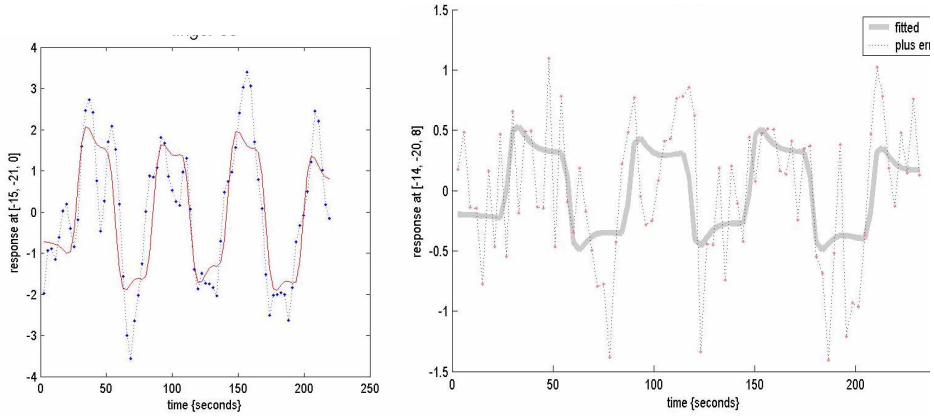

Fig. 2: Signal response due to finger tapping at 7 T (left plot) and 1.5 T (right plot) in thalamic region.