PHYSICS

BIOPHYSICAL BASIS OF FMRI:
INSIGHTS FROM HIGH SPATIAL RESOLUTION STUDIES OF PRIMATES

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Dissertation under the direction of Professor John Gore

In the research described, we developed methods and protocols for high-spatial resolution functional magnetic resonance imaging (fMRI) of cortical activity in the brains of anesthetized non-human primates with sub-millimeter spatial specificity. These methods have been used to study the neural architecture of somatosensory areas in squirrel monkeys using BOLD fMRI at 9.4T. The stability and reproducibility of the fMRI data have been investigated and evaluated within and between different animals. We have shown how these high-resolution fMRI techniques may be combined with invasive electrophysiology and optical imaging methodologies to assess brain function more comprehensively. In addition to positive BOLD signals elicited by vibrotactile stimuli, negative BOLD responses were found adjacent to positive BOLD responses in area 3b. The dependences of both the positive and the negative BOLD responses on stimulus intensity have been quantified. The activity within other regions such as SII has also been evaluated. In a separate study, we evaluated the relaxation behavior of paramagnetic metal ions in different brain regions to assess whether MRI can be used to quantify brain

levels of such metals, and how these properties may affect the use of manganese as a tracer for imaging neuronal tracts.

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