Development and Evaluation of Data Collection and Analysis Strategies for Functional Magnetic Resonance Imaging (fMRI)

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Functional magnetic resonance imaging (fMRI) exploits regional differences in the oxygenation state of cerebral blood, known as blood oxygenation-level dependent contrast (BOLD), to detect and localize changes in brain activity. Since the contrast media is endogenous, BOLD-fMRI is a non-invasive method for evaluating eloquent brain function in both normal and patient populations without the use of ionizing radiation.

At a clinical field strength of 1.5 tesla, the BOLD signal change is small ranging from 1-3% from the background signal level for gradient-echo MR pulse sequences. Thus, the data collection and analysis strategies used in fMRI have a direct impact on the ability to accurately and reliably detect the small signal changes accompanying modulations in brain function.

By studying the effects of the fMRI data collection and analysis process, fMRI guidelines can be established that will increase the reliability and the quality of the functional data collected. Therefore, the primary focus of this thesis was the evaluation of fMRI data collection and analysis strategies in order to improve the quality of fMRI data.