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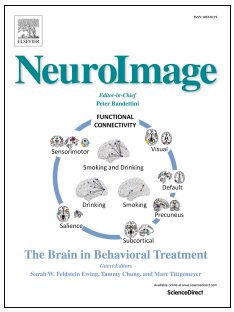

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Impacts of Simultaneous Multislice Acquisition on Sensitivity and Specificity in fMRI

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Abstract

Simultaneous multislice (SMS) imaging can be used to decrease the time between acquisition of fMRI volumes, which can increase sensitivity by facilitating the removal of higher-frequency artifacts and boosting effective sample size. The technique requires an additional processing step in which the slices are separated, or unaliased, to recover the whole brain volume. However, this may result in signal "leakage" between aliased locations, i.e., slice "leakage," and lead to spurious activation (decreased specificity). SMS can also lead to noise amplification, which can reduce the benefits of decreased repetition time. In this study, we evaluate the original slice-GRAPPA (no leak block) reconstruction algorithm and acceleration factor (AF = 8) used in the fMRI data in the young adult Human Connectome Project (HCP). We also evaluate split slice-GRAPPA (leak block), which can reduce slice leakage. We use simulations to disentangle higher test statistics into true positives (sensitivity) and false positives (decreased specificity). Slice leakage was greatly decreased by split slice-GRAPPA. Noise amplification was decreased by using moderate acceleration factors (AF = 4). We examined slice leakage in unprocessed fMRI motor task data from the HCP. When data were smoothed, we found evidence of slice leakage in some, but not all, subjects. We also found evidence of SMS noise amplification in unprocessed task and processed resting-state HCP data.

Keywords: false negatives, false positives, multiband, noise amplification, parallel imaging, slice-GRAPPA, slice leakage

1 Introduction

The rapid evolution in simultaneous multislice (SMS) imaging techniques has led to large decreases in image acquisition time, which has increased the temporal resolution in functional magnetic resonance imaging (fMRI) and improved tractography in diffusion MRI. In SMS imaging, a multiband

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