Abstract View

MULTITAPER ANALYSIS OF PHASE-ENCODED FUNCTIONAL IMAGING DATA

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Retinotopic mapping with functional MRI is typically carried out using a phase-encoding experimental design. In phase encoding, a temporally periodic stimulus (such as a rotating wedge or expanding ring) is displayed. The amplitude and phase of the fMRI signal at the stimulation frequency is then estimated, usually by a simple Fourier transform (or periodogram). Two hypothesis tests are commonly used to check the significance of this estimate. In the first [Press et al 2001, Engel et al 1996], the correlation between the assumed signal waveform and the measured signal is calculated and tested against the null hypothesis of zero correlation. In the second method [Sereno et al 1995], the signal is assumed to be a line component against a background of Gaussian white noise. The signal to noise ratio is then distributed as an F statistic under the null hypothesis of no signal. The approximately 1/f spectrum of MR noise [Zarahn et al 1997] leads the F-statistic approach to be lenient at at low frequencies and conservative at high frequencies. Here, we consider an alternative estimator based on Thomson's (1982) multitaper technique, which requires the less restrictive assumption of "locally" white noise. For equivalent false positive rates, estimated by testing at non-stimulus frequencies, the multitaper method is typically on the order of 10% more powerful than F statistic or correlational approaches. Additionally, the local nature of the multitaper hypothesis test makes it well suited to experiments where multiple stimuli are presented simultaneously at different periodicities, leading to greater experimental efficiency. We present these results using both simulated and actual data from retinotopic mapping experiments.

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