Intensity-based masking: A tool to improve functional connectivity results of resting-state fMRI.

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Abstract:

Seed-based functional connectivity (FC) of resting-state functional MRI data is a widely used methodology, enabling the identification of functional brain networks in health and disease. Based on signal correlations across the brain, FC measures are highly sensitive to noise. A somewhat neglected source of noise is the fMRI signal attenuation found in cortical regions in close vicinity to sinuses and air cavities, mainly in the orbitofrontal, anterior frontal and inferior temporal cortices. BOLD signal recorded at these regions suffers from dropout due to susceptibility artifacts, resulting in an attenuated signal with reduced signal-to-noise ratio in as many as 10% of cortical voxels. Nevertheless, signal attenuation is largely overlooked during FC analysis. Here we first demonstrate that signal attenuation can significantly influence FC measures by introducing false functional correlations and diminishing existing correlations between brain regions. We then propose a method for the detection and removal of the attenuated signal ("intensity-based masking") by fitting a Gaussian-based model to the signal intensity distribution and calculating an intensity threshold tailored per subject. Finally, we apply our method on real-world data, showing that it diminishes false correlations caused by signal dropout, and significantly improves the ability to detect functional networks in single subjects. Furthermore, we show that our method increases inter-subject similarity in FC, enabling reliable distinction of different functional networks. We propose to include the intensity-based masking method as a common practice in the pre-processing of seed-based functional connectivity analysis, and provide software tools for the computation of intensity-based masks on fMRI data. Hum Brain Mapp 37:2407-2418, 2016. © 2016 Wiley Periodicals, Inc.

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