Alternative based thresholding for pre-surgical fMRI

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Abstract

fMRI is a non-invasive neuroimaging technique that enables to locate important psychological tasks in the brain. The procedure plays a major role in pre-surgical planning for patients with resectable brain lesions such as tumors. fMRI studies can guide resection, thereby preserving vital brain tissue.
For an fMRI data analysis, the brain is divided in more than 100,000 voxels. For each voxel, a statistical test classifies the voxel either as active or as unrelated to the task. In cognitive neurosciences, focus lies on controlling the false positive rate to account for the huge multiple testing problem that arises. However, stringent control of false positives implies an increase of false negatives which can be detrimental in clinical settings where false negatives may lead to surgical resection of vital brain tissue. Consequently, we argue for a testing procedure with a stronger focus on preventing false negatives.
We present a thresholding procedure that incorporates information on both false positives and false negatives. We combine 2 measures of significance for each voxel: a classical p-value which reflects evidence against the null hypothesis of no activation and an alternative p-value which reflects evidence against activation with a pre-specified size. This results in a layered statistical map for the brain. One layer consists of voxels exhibiting strong evidence against the null of no activation while a second layer is formed by voxels for which activation cannot be confidently excluded. The third level then shows voxels for which the presence of activation can be rejected.

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