Searchlight Back-projection - A Tool for Analyzing Neural Signatures in Visual Space

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Introduction

- FMRI-based population receptive fields (pRFs) can be used to back-project differential fMRI responses into visual space. Usually, this involves summation of Gaussians [1], which can result in blurry back-projection profiles, hampering interpretation.

- Here, we present a novel approach implementing a searchlight algorithm with a fixed or flexible searchlight size, allowing for fine-grained analyses of back-projected activity profiles.

fMRI Experiments

Retinotopic Mapping Experiment

- N_{Part} = 5
- Carrier: Intact or phase-scrambled natural images
- N_{Run} = 3 | Stimulation blocks: 90 s | Baseline blocks: 30 s

Dots Quadrant Experiment

- N_{Part} = 5 of the retinotopic mapping experiment
- Carrier: Random dot kinematogram
- N_{Run} = 16 | Stimulation blocks: 30 s | Baseline blocks: 15 s

Results

Standard [Radius: 1°]

Activity increase in stimulated and decrease in non-stimulated sites

Highest correlation btw. observed and predicted back-projections of the original dots stimulus

Decrease in magnitude of correlation btw. observed and predicted back-projections with smaller/no searchlights

Nearest Neighbors [N_{voxels} = 30]

Searchlight Approach

Using each voxel’s pRF center position, observed or predicted measures of each voxel are back-projected into visual space. Usually, this involves summation of Gaussians [1], which can result in blurry back-projected activity profiles. For reasons of visibility, both searchlight grids were downsampled by a factor of 2.

No searchlight

Discussion

- Our findings for both searchlight algorithms replicate research on stimulus-evoked retinotopic activation [2] and image identification using pRFs [3]. They further indicate that local inhomogeneities between observed and predicted back-projection profiles reduce their magnitude of correlation.

References