This abstract fills a gap in the random field theory for the P-value of local maxima of SPMs from multivariate linear models for image data. Examples of multivariate image data are: vector deformations to warp an MRI image to an atlas standard, diffusion tensors, and the HRF sampled at 1s intervals. Examples of multiple contrasts are: several polynomial effects, several performance measures, or differences between several groups. So far results are only available for either one variate or one contrast:

<table>
<thead>
<tr>
<th>Random Field Theory</th>
<th>Number of contrasts, p</th>
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<tbody>
<tr>
<td>Number of variates, q</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>T [1]</td>
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<tr>
<td></td>
<td>F [1]</td>
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<td></td>
<td>Hotelling’s T² [2]</td>
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For multivariate data and multiple contrasts, there are several different test statistics, all based on the eigen values \(W_q\) if \(\text{rank}\{B\} = 1\), and that at all other voxels. If the reference voxel is varied as well, the correlation between multivariate image data at a single reference voxel, assessed by the maximum Hotelling’s statistic SPM with \(p = 1\), \(m = 34\), \(t = 54.0\), \(P = 0.05\), corrected. The closeup shows that the damage is an outward movement of the anatomy, either due to swelling of the ventricles or atrophy of the surrounding white matter. The reference voxel of maximum Hotelling’s T², used for the connectivity, is marked by the intersection of the three axes.

**Example: Deformation Based Morphometry**

- \(n_1 = 17\) patients with non-missile brain trauma who were in a coma for 3-14 days.
- \(n_2 = 19\) age and sex matched controls

MRI images were taken after the trauma, and the multivariate data were the \(q = 3\) component vector deformations needed to warp the \(n = 36\) MRI images to an atlas standard, sampled on a 2mm voxel lattice. Damage is expected in white matter areas, so the search region \(S\) was defined as the voxels where smoothed average control subject white matter density exceeded 5%. For calculating the resels, this was approximated by a sphere with the same volume, 1.31cc. The effective FWHM, averaged over the search region, was 13.3mm.

**Where is the damage?**

Trauma minus control average deformations (arrows and color bar), sampled every 6mm, with Hotelling’s T² statistic for significant differences (\(p = 1\), \(m = 34\), \(t = 54.0\), \(P = 0.05\), corrected). The closeup shows that the damage is an outward movement of the anatomy, either due to swelling of the ventricles or atrophy of the surrounding white matter. The reference voxel of maximum Hotelling’s T², used for the connectivity, is marked by the intersection of the three axes.

**Where is the connectivity modified by the trauma?**

Regions where the connectivity is different between trauma and control groups (as in [4]), assessed by Roy’s maximum root \(R\) (\(p = 3\), \(m = 28\), \(t = 30.3\), \(P = 0.05\), corrected). The small region in the contralateral hemisphere is more correlated with the reference voxel in the trauma group than the control group.

**Regions where effective anatomical connectivity with the reference voxel, assessed by the maximum canonical correlation \(C\) (\(p = 3\), \(m = 31\), \(t = 0.746\), \(P = 0.05\), corrected). Reference voxel is ‘connected’ with its neighbours (due to smoothness) and with contralateral regions (due to symmetry).**

**References**


June 16, 2004