INCREASED DETECTION SENSITIVITY IN FMRI BY ADAPTIVE FILTERING

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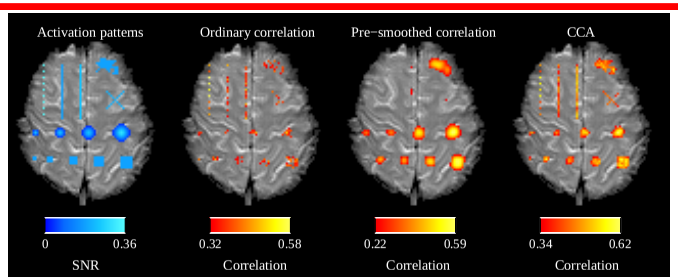
SUMMARY

A method for detecting neural activity in BOLD fMRI is derived as a natural extension of established analysis methods. The new method, which is based on Canonical Correlation Analysis, has an inherent adaptive spatial filtering property which improves the detection sensitivity.



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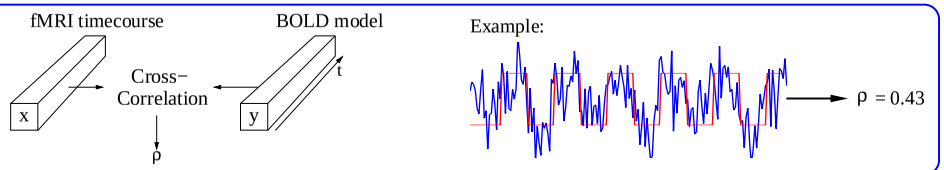
REFERENCES

[1] Friman O et al. (2001) Magn. Reson. Med. 45(2) : 323−330

[2] Ardekani B et al. (1998) Magn. Reson. Imag. 16(10) : 1217−1225

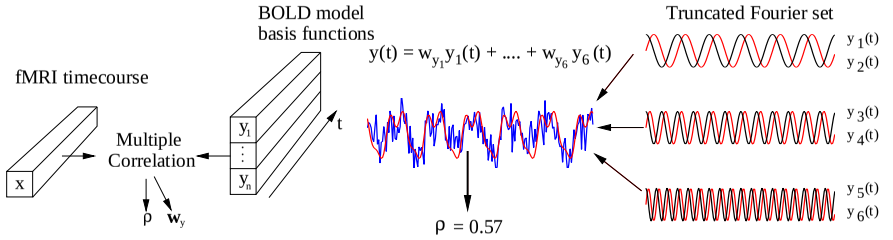
ORDINARY CORRELATION ANALYSIS

- Presently, the most widely used methods for detecting activity in BOLD fMRI are the t−test and the ordinary cross−correlation.
- It is well known that these methods are equivalent.



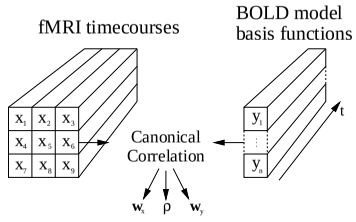
MULTIPLE CORRELATION ANALYSIS

- A single timecourse y(t) is not able to model the variations in the BOLD response.
- Instead a set of basis functions $y_i(t)$, i = 1...n, can be used.
- A Multiple Correlation Analysis between an fMRI voxel timecourse x(t) and the set of basis functions finds the linear combination of the basis functions which correlates the most with the voxel timecourse. This is equivalent to an F−test.

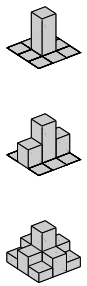


CANONICAL CORRELATION ANALYSIS

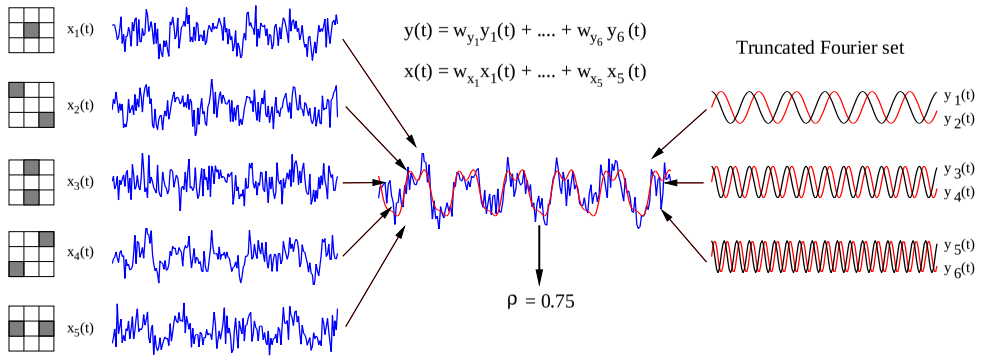
- Analyzing voxels separately does not provide the desired detection sensitivity, and scattered active voxels is a characteristic result.
- A widely used approach is to smooth the fMRI images with a Gaussian shaped filter.
- A better approach is however offered by Canonical Correlation Analysis.



By partitioning the 3x3 region as indicated to the right, different symmetric spatial adaptive filters are obtained.



$x(t) = w_{x_1} x_1(t) + ... + w_{x_5} x_5(t)$



CONCLUSION

Detection sensitivity is improved with the Canonical Correlation method. Smoothing the 3x3 region with a Gaussian filter and using the truncated Fourier set yields a correlation of $\rho = 0.66$.