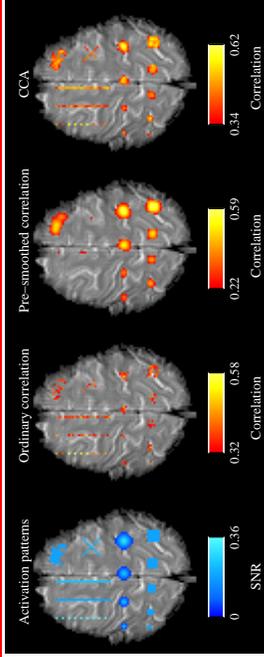


INCREASED DETECTION SENSITIVITY IN FMRI BY ADAPTIVE FILTERING

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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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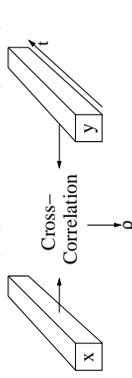
REFERENCES

- [1] Friman O et al. (2001) Magn. Reson. Med. 45(2) : 323-330
- [2] Ardekani B et al. (1998) Magn. Reson. Med. 16(10) : 1217-1225

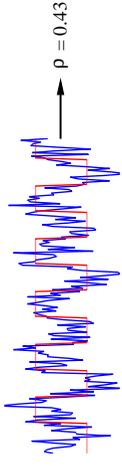
ORDINARY CORRELATION ANALYSIS

- 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.

fMRI timecourse



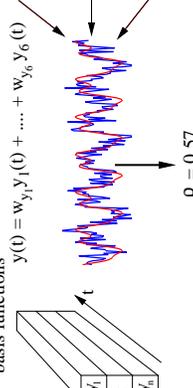
Example:



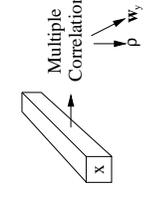
MULTIPLE CORRELATION ANALYSIS

- 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.

BOLD model basis functions

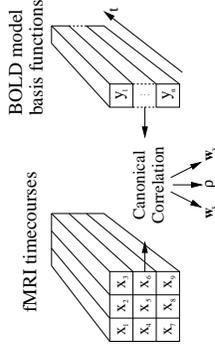


fMRI timecourse



CANONICAL CORRELATION ANALYSIS

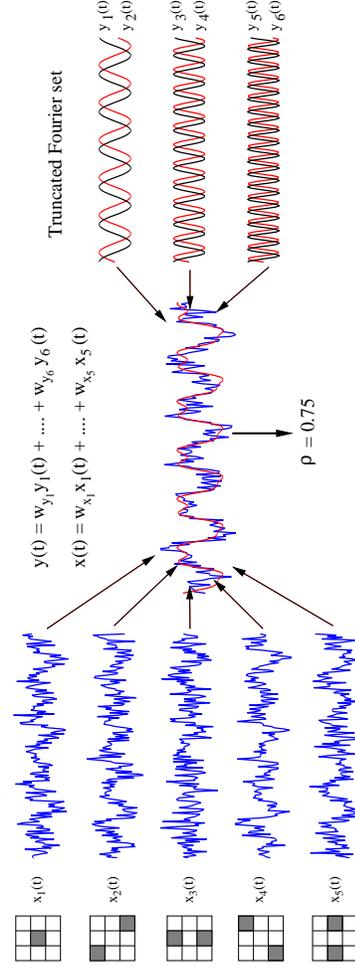
- Analyzing voxels separately does not provide the desired detection sensitivity, and scattered active voxels is a characteristic result.
- A widely used approach is to smooth the fMRI images with a Gaussian shaped filter.
- A better approach is however offered by Canonical Correlation Analysis.



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



$$x(t) = w_{x1}x_1(t) + \dots + w_{x5}x_5(t)$$



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 $\rho = 0.66$.