Canonical Ridge Analysis with Ridge Parameter Optimization
Description of slides

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May 25, 1998

1 First slide: The formula and an example

The first slide shows a simplification of the central formula of the Canonical Ridge Analysis. $\mathbf{G}$ is a design matrix containing the design (paradigm, repetition, ...) and $\mathbf{X}$ is a data matrix containing the scaning data ("voxel data"). The data matrix is normalized by a covariance matrix. It is this covariance matrix we want to regularize with the so-called *ridge* technique. With a proper optimization the regularization should help us to obtain a more generalizable pattern of the neuroimaging data, — better than the ordinary multivariate linear analyses. The k parameter makes it possible to interpolate (or mix/morph) between a Canonical Correlation Analysis and a Partial Least Square Analysis. Thus Canonical Ridge Analysis is a generalization of Partial Least Square and Canonical Correlation Analysis making it possible to take advantage of the two models different capabilities.

What the formula does not show is that an initial singular value decomposition is needed, and to obtain the final images and sequences we need to normalize the result (the $\mathbf{U}$ and the $\mathbf{V}$ matrices).

The figure with the eight plots shows results from an analysis of a single-subject fMRI study with a sequential finger opposition paradigm performed at the Massachusetts General Hospital. The upper row contains the first eigenimages — or as we call it — canonical images. The leftmost is from a Canonical Correlation Analysis and the rightmost from a Partial Least Square Analysis. The third from left is the result from Canonical Ridge Analysis with the optimal k (for this specific data set), and the second from left is the result where the ridge parameter is sat somewhere between the optimal k and the Canonical Correlation Analysis value $k = 0$.

The lower row is what we call eigensequences — or canonical sequences. They are corresponding to the canonical images.

The canonical image and the canonical sequence are more or less picking up random noise. The Partial Least Square is picking up some "structured noise". The Canonical Ridge Analysis is not just a compromise between the two, but a more optimal model emphasizing primary motor area and SMA.

The color scale is yellow/red for positive and blue for negative. Black is zero.

2 Second slide: Pros and cons

The second slide just shows a short list of the pros and cons of the different analyses.