Decoding the auditory brain with canonical component analysis

The relation between a stimulus and the evoked brain response can shed light on perceptual processes within the brain. Signals derived from this relation can also be harnessed to control external devices for Brain Computer Interface (BCI) applications. While the classic event-related potential (ERP) is appropriate for isolated stimuli, more sophisticated "decoding" strategies are needed to address continuous stimuli such as speech, music or environmental sounds. Here we describe an approach based on Canonical Correlation Analysis (CCA) that finds the optimal transform to apply to both the stimulus and the response to reveal correlations between the two. Compared to prior methods based on forward or backward models for stimulus-response mapping, CCA finds significantly higher correlation scores, thus providing increased sensitivity to relatively small effects, and supports classifier schemes that yield higher classification scores. CCA strips the brain response of variance unrelated to the stimulus, and the stimulus representation of variance that does not affect the response, and thus improves observations of the relation between stimulus and response.