Functional boost for magnetic resonance imaging

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Over the last few years, researchers have used a type of brain scanning, known as functional magnetic resonance imaging fMRI, to help them map changes in blood flow in the brain and to correlate this with thoughts and behavior. A new way to analyze fMRI data, which could improve is reported in the *International Journal of Computational Biology and Drug Design*.

Scientists have known since the 1890s that changes in blood flow and blood oxygenation in the brain (hemodynamics) are correlated with activity in brain cells, neurons. When a neuron is active it needs more energy from glucose and this demand increases blood flow to the regions of the brain where there is more neural activity. This leads to local changes in the relative concentration of oxyhemoglobin and deoxyhemoglobin and changes in local cerebral blood volume and in local cerebral blood flow, which researchers have been measuring using fMRI since the early 1990s. Since then, brain mapping using this relatively non-invasive technique, which also avoids exposure to ionizing radiation has become more and more widely used.

Researchers have used fMRI to study brain development and function, to diagnose problems following injury and to predict when a person might be fit enough to return to work, as an alternative to lie detectors, to allegedly peer into a person's dreams, and even to communicate with patients in a vegetative state. Many of the experiments that have received attention in the news media are controversial in that interpreting images of changing blood flow in the brain is only a proxy of actual activity

Moreover, extrapolating those proxy images to thoughts and behavior involves a not in significant extrapolation.

Now, Chuan Li and Qi Hao of the Department of Electrical and Computer Engineering, at The University of Alabama, Tuscaloosa, have developed a more robust, three-stage approach to fMRI that could improve the detection of neural activity considerably and allow researchers to make more precise interpretations of fMRI data.

The team explains that there are three stages to their approach: prediction, modeling and inference. Prediction involves identifying regions of interest associated with an extraordinary amount of neural activity through Temporal Clustering Analysis (TCA). Modeling involves categorizing the fMRI signals related to neural activity into event prototypes through Linear Predictive Coding (LPC). Finally, inference is the determination of the types of neural activity taking place in terms of activation, deactivation and normality using a type of statistical analysis known as Bayesian inference.

Their approach side-steps to some extent the problems inherent in current approaches to fMRI, namely low signal-to-noise ratio, high data volumes, differences between patients or subjects and artifacts caused by the movement of the person being scanned. Their approach allows them to turn large amounts of often noisy data into discrete sequences of neural activity events. The team has demonstrated how well their approach works by analyzing data from fMRI scans on volunteers involved in the simple activities of drinking a glass of water or a glass of glucose solution.

"Our expertise is in signal processing and machine learning. Our research goal is to develop a set of powerful signal processing tools for fMRI researchers," says Hao.

More information: "Compressive neural activity detection with fMR images using Graphical Model Inference" in *Int. J. Computational Biology and Drug Desig*n, 2010, 3, 187-200

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