Specialty area: Single-Subject Neuroimaging

Xiaoping Hu xhu3@emory.edu

Title: Real-Time fMRI, Brain States & Biofeedback

Target audience: This talk is targeted for practitioners of fMRI in basic and clinical neuroscience.

OUTCOME/Objectives: The audience is expected to obtain a basic understanding of the technical aspects of real-time fMRI and challenges of doing it in single subjects.

PURPOSE: Real-time fMRI is a powerful application of fMRI and can be used in brain state "reading," brain computer interface, and biofeedback. While real-time fMRI is ideally conducted at the single-subject level, it is often limited by inter-subject variability and signal (contrast)-to-noise ratio. The purpose of this talk is to provide a brief technical overview and discuss some technical challenges.

METHODS and DISCUSSIONS: Real-time fMRI could be performed by focusing on the fMRI response of a predefined ROI [1] or by examining the entire imaged volume using a classifier [2]. While the former is straightforward, it requires the knowledge of the target ROI which may not be available and vary from subject-to-subject, and its sensitivity could be limited by the size of the ROI. The latter requires the establishment of the classifier using training before the actual real-time experiment. The classifier training could be time consuming, and training done at a group level may not be generalizable to individual subjects due to intersubject variability. In addition, the performance of the classifier may also be sensitive to noise and motion artifact in the data. Furthermore, both types of approaches could be affected by changes in task performing strategy and limited in temporal resolution due to the hemodynamic response and image acquisition speed. All these issues present problems for single-subject fMRI and need to be taken into account in the experimental design.

CONCLUSION: In conclusion, real-time fMRI is viable for single subject applications but its robustness is limited by a few factors.

REFERENCES:

1. deCharms RC, Maeda F, Glover GH, Ludlow D, Pauly JM, Soneji D, Gabrieli JDE, and Mackey SC. Control over brain activation and pain learned by using real-time functional MRI. PNAS, 102 (51): 18626-31, 2005.

2. LaConte S, Pelter S, and Hu X. Real-time fMRI using brain state classification. Human Brain Mapp 28(10):1033-44, 2007.