Course: Pitfalls in Diffusion-Perfusion-fMRI quantification processing: What artifacts should I worry about in practice?
Organizer: Fernando Calamante, PhD.

Lecture 2: Perfusion MRI: Dynamic-susceptibility contrast MRI
Speaker: Dr. Timothy J. Carroll, PhD, Northwestern University, USA

Case-based Teaching

Learning Objectives: identify common sources in image artifact in DSC perfusion imaging.

Dynamic susceptibility contrast MRI is a widely used means to create images of cerebral perfusion. These images have gained widespread acceptance as a means of evaluation cancer, stroke and the hemodynamic compromise secondary to neurovascular disease.

The acquisition of DSC perfusion-weighted images requires the use of dynamically acquired, highly susceptibility weighted (T2 or T2*) images. Concurrent with the acquisition of these images is the intravenous injection of a small bolus (10 – 20 cc’s) of a gadolinium based paramagnetic contrast agent. The passage of the bolus of contrast agent through the intracranial vasculature and brain parenchyma is recoded as a time-series of images. Parametric images of Cerebral Blood Flow (CBF), Cerebral Blood Volume (CBV) and Mean Transit Time (MTT) are calculated through a deconvolution analysis of these images.

Artifacts which affect image quality, and ultimately image interpretability will be discussed. In this course we will review the basics of DSC perfusion image acquisition as they relate to image artifacts. Three major categories of image artifact will be discussed separately: EPI artifact, artifacts related to the contrast bolus passage and those related to post-processing errors.

The need for high frame rate highly susceptibility weighted images dictates the use of single-shot Echo Planar Image (EPI) acquisitions. Cases showing EPI artifacts related to: off resonance fat signal miss registration, signal dropout near frontal sinuses and auditory canal, EPI blurring, N/2 ghosting will be presented. The mitigation of these effects will be presented. Furthermore accurate measurement of perfusion in cortical gray matter can be confounded in the presence of the overwhelming signal in the distal branches of the middle cerebral arteries. Strategies to address this effect will be shown.

The post processing of MRI perfusion weighted images has been greatly facilitated through the use of vendor (or third party) supplied software packages. However improper use of these analysis package and the resulting errors can lead to spurious results. Artifacts related error in the used of post processing packages, in addition cases related to the delay-dispersion of the contrast bolus effects will be shown.

Upon completion of this course, participants will able to identify image artifact related to EPI image acquisition, bolus dynamics and post-processing errors common to DSC perfusion imaging.