PC VIPR: Phase Contrast with 3D Undersampling Projection Reconstruction

Tianliang Gu

Under the supervision of Professor Charles A. Mistretta
At the University of Wisconsin-Madison

May 16, 2004

MR phase contrast (PC) technique provides a method to acquire in vivo quantitative flow information as well as qualitative angiographic images with clean background subtraction. 3D PC with high isotropic spatial resolution covering a large imaging volume requires a prohibitively long scan time in clinical practice, although it is free from the time-consuming process of 2D image plane selection. The recently developed 3D undersampling projection reconstruction technique, VIPR, can image a large volume with high isotropic spatial resolution in a short scan time, by vastly reducing the total number of the 3D projections. PC with VIPR (PC VIPR) has been developed in this thesis to provide fast PC acquisitions. High isotropic spatial resolution angiographic images in large imaging volumes are acquired using PC VIPR faster than with the conventional techniques 3D Cartesian, PC or 3D TOF. PC VIPR is not sensitive to pulsatile flow artifacts. Therefore, accurate average flow rates can be obtained in any vessels in the image view without ECG gating. ECG gating can also be conveniently incorporated into PC VIPR to provide time-resolved flow information of any vessels in the image view as well as the time-resolved angiographic images. Velocity space can also be resolved to provide flow spectra in a large 3D image volume. PC VIPR with multi-echo readout has also been developed and preliminary results are discussed in this thesis.