Recent Developments in Time-resolved CE-MRA Using VIPR

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Introduction: Contrast-enhanced 3D undersampled projection MRA techniques such as VIPR can image the entire thoracic or abdominal cavity with high spatial resolution. Temporal resolution is also achieved by using a sliding window reconstruction in which the temporal aperture widens with k-space radius. The technique has been adapted for cardiac, peripheral, phase contrast, T2-weighted, and moving table imaging. The aperiodic, non-Cartesian undersampled trajectory coupled with the temporal filter present many challenges, but also opportunities to improve CNR, image sharpness, and shorten scan times.

Methods: All studies were performed on a 1.5T GE CardioVascular (CV/i) magnet. CNR is improved as fewer static structures generate signals that alias. Methods to periodically interrupt the imaging sequence to suppress fat, the major static signal generator, are presented. Signal outside the FOV is made less coherent by modifying the method used to select the endpoints of the projections and slightly randomising their locations [1]. Since the sampling points are aperiodic, we have studied doing density correction using the techniques developed by Pipe [2]. Eddy currents causing undesired k-space shifts are measured by acquiring projections with alternating polarities along each gradient axis (300 ms total time). A phase difference between projections of opposite polarity indicates a k-space shift that can be corrected when the radial scan data is regridded. The k-space shift for any arbitrary projection direction is the linear combination of the individual gradient corrections.

Results and Discussion: Methods to randomise signal from outside the FOV have removed the need to acquire a mask acquisition prior to contrast injection for later mask subtraction. Reweighting the data using the Pipe method has resulted in sharper images and better depictions of background objects. Eddy current measurements have detected k-space shifts from ½ to an entire sample point. Corrections of these errors have removed signal pileups and improved image sharpness. Clinical exams have been shortened from 40 s to 24 s.

[1] E. Brodsky *et al.*, Proceedings of the ISMRM, 2002, p. 141.

[2] J. Pipe, Reconstructing MR Images from Undersampled Data, MRM, 43:867-875, 2000.