HIGH RESOLUTION CONTRAST-ENHANCED MAGNETIC RESONANCE ANGIOGRAPHY USING TIME-RESOLVED ACQUISITION AND VESSEL SEGMENTATION

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

In contrast-enhanced Magnetic Resonance Angiography (CE-MRA), acquisition of low spatial frequency data has been limited to the time between arterial and venous opacification. This limits the SNR of the angiogram and is of particular concern for high resolution angiograms that require sufficient SNR for vessel depiction. Averaging of high spatial frequency k-space data can provide some increase in SNR, but the full benefit of signal averaging requires inclusion of all spatial frequencies. This thesis discusses a spatial frequency representation of objects that enhance at a different rate than the arteries, such as veins, from angiograms. This allows acquisition and signal averaging of all spatial frequencies after venous opacification. A dual-phase data acquisition is presented that consists of a time-resolved phase followed by repeated acquisition of high spatial resolution k-space volumes. Following removal of unwanted low spatial frequency signals, k-space data points are subjected to temporal matched-filtering, and combined to form a high resolution, high SNR angiogram. Unaltered high spatial frequency data are used to increase the resolution of the time-resolved and matched-filtered images. The method is applied in conjunction with the injection of intravascular and extracellular contrast agents.