Developing new strategies for high resolution imaging at ultra-high field human MRI

Abstract:

Today, ultra-high-field MRI is at the forefront of the development for high-precision non-invasive imaging, capable of distinguishing between brain layers. In our lab, we utilize ultra-high field MRI to develop methods to increase the spatial and temporal resolution in scans that capture the structure and function of the human brain. We explore methods that can control the signal we collect, optimizing MRI signal encoding, scan acceleration and strategies of the signal acquisition, followed by computational approaches to improve the final image. I will show three examples. One is developing methods to increase temporal resolution in functional MRI, exploring strategies to capture the delay between neural processes. Another is developing quantitative method to characterize neurovascular and physiological changes in the human brain. With this technique, we are interested to follow the changes in the brain with age, gender and population, thus providing new insights for basic neuroscience and long-term personalized medicine. The last example shows how we can minimize a major sensitivity that is common to 3D whole brain acquisition: sensitivity to fluid movement during the scan duration, which results in severe artifacts in the images. This includes fluid in the ventricles that beats with cardiac pulsation, fluid movement in the eyes while moving our gaze and the blood flow in small vessels.