

ISMRM 2014 Syllabus  
Sunshine “Brain MRI Fingerprinting”

Magnetic Resonance Fingerprinting (MRF) is a novel framework for simultaneous accurate quantitation of multiple MR tissue properties (Ma, D, et al. *Nature*. 2013 March 14; 495(7440): 187–192). MRF permits the non-invasive quantification of multiple important properties of a material or tissue simultaneously through a new approach to data acquisition, post-processing and visualization. MRF provides a mechanism to quantitatively detect and analyze complex changes that can represent physical alterations of a substance or early indicators of disease. When paired with an appropriate pattern recognition algorithm, MRF inherently suppresses measurement errors and thus can improve accuracy compared to previous approaches. We begin our study of MRF to quantify T1 and T2 relaxation times in application to different brain regions in normal adults, and for evaluating intra-axial brain tumors.

As MRF allows simultaneous, rapid, in vivo quantification of relaxation parameters of brain, the obtained normal T1 and T2 relaxometry values in different brain regions can provide baseline measurements for comparison with different disease related states. Age-based analysis shows significant differences in T1 or T2 relaxation parameters of specific anatomic brain regions including superior frontal white matter, centrum semiovale as well as deep or posterior structures such as pons and cerebellum. MRF enables a high efficiency collection of these data and continues to show concurrence with published literature of values obtained with other, though less efficient techniques.

This novel magnetic resonance fingerprinting technique also can allow us to analyze differences in relaxometry measurements not only based on gender and age, but also for example for tumor or edema. Perhaps most excitingly our use of MRF can quantitatively distinguish tumors, dissect the components of peri-lesional white matter and show clear delineation from normal contra-lateral white matter. Specifically early measurements support using MRF to identify regions of infiltrative non-enhancing tumor in high-grade gliomas beyond the typical margins of enhancement borders. These data in turn may permit further non-invasive tumor differentiation, and evaluation of therapeutic response.