Model-Based Reconstruction Methods for Accelerated MR Parameter Mapping

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Mapping parameters of analytical MR signal models may offer more sensitive, specific, and system-independent information about disease substrates than conventional anatomical MR images. However, as MR parameter mapping requires multiple measurements along the additional (parametric) dimension (e.g., echo time in T_2 mapping), it may be time-consuming and even incompatible with existing constraints on MRI acquisition time. Hence, accelerated parametric mapping has been an active area of MRI research for long time.

A typical MR parameter mapping procedure first reconstructs images from multiple *k*-space acquisitions and then performs a pixel-wise fit of the model to the image series. Such sequential procedure fails to optimally utilize all available information about the problem (acquired data and signal model) for the benefit of improved reconstruction of under-sampled (accelerated) data. Recently, several research groups proposed to utilize analytical signal models and *k*-space data simultaneously in joint reconstruction schemes. They demonstrated a significant potential of the joint reconstruction to facilitate higher accelerations in MR parameter mapping.

This talk will review modern state-of-art approaches to model-based reconstruction of MRI data for accelerated parameter mapping. Additionally, it will discuss limiting aspects of such techniques including sensitivity to modeling errors. Such errors are often caused in practice by inconsistency between the mathematical model and actual signal evolution in the parametric dimension due to modeling simplifications, partial voluming, imaging imperfections, and motion artifacts. We will describe several new model-based reconstruction algorithms to minimize such errors. The methods will be illustrated by examples of accelerated mapping of fundamental MR parameters.