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# Automated Optimization of Dynamic MRI Data Acquisition and Reconstruction Parameters using Image Quality Metrics (I)

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Dynamic Magnetic Resonance Imaging (MRI) acquisitions –e.g. the acquisition of Dynamic Contrast Enhanced MRI for the determination of pharmacokinetic model parameters –are challenging due to their requirement for simultaneous spatial and temporal resolution. This is in particular true for applications of DCE-MRI in areas such as prostate cancer, where the dynamics can be rapid (on the order of seconds) and the spatial extent of structures small (on the order of millimeters).

The use of sparse data methods, notably Compressed Sensing (CS), can dramatically improve temporal resolution through under-sampling of k-space. However this comes at the expense of spatiotemporal contrast fidelity, which affect quantitative accuracy and clinical detectability, due to the effects of data compression and regularization. CS DCE-MRI often requires that the under-sampling factor be determined a priori, and furthermore there exists no framework for selecting the optimal regularization for the under-sampled data set.

More recently, "golden angle" under-sampling approaches have been proposed, in which data is acquired continuously, and during post-processing the data can be re-sampled to trade off temporal resolution with under-sampling factor. However, there exists no framework to objectively determine the under-sampling factor and regularization that are best suited to answer the relevant question (e.g., determining the Arterial Input Function, calculating Ktrans, etc). Typically, these decisions are either made on the basis of arbitrarily setting a target temporal resolution, or by measuring the root mean square error (RMSE).

We have recently studied the use of image quality metrics such as the Structural Similarity Image Metric, Feature Similarity Index Metric, and others. These metrics were first proposed in the computer imaging literature for characterizing the effect of data compression (e.g. JPEG) on natural images. Specifically, they were developed because they have been shown to better correlate with perceptual changes in image quality than RMSE. Our work has examined the use of these metrics, applied in the individual image domain, to objectively determining the under-sampling factor and regularization that correlates with data fidelity of the overall dynamic time series.

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