Accelerated Radial Imaging with Compressed Sensing Reconstruction for Breast DCE-MRI

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Abstract

Breast cancer is one of the most common diseases for the female population across all ages and is one of the most common causes of cancer death in females. MRI of the breast has been shown to provide very high sensitivity for breast cancer, primarily due to the use of intravenous contrast agents that enable not only morphologic evaluation but also the ability to visualize neoangiogenesis associated with tumor progression. Therefore, DCE-MRI is a powerful tool for diagnostic screening, evaluation for extent of disease, and treatment planning and monitoring. However, conventional Cartesian acquisition requires a tradeoff between spatial and temporal resolution. The lesion curves measured from conventional DCE-MRI, with high spatial resolution but low temporal resolution imaging protocols, are not sufficient to characterize the contrast dynamics. This results in only moderate specificity for characterizing different lesion types.

With recent advances in MRI, many studies have proposed advanced acquisition and reconstruction approaches to achieve high temporal resolution while still maintaining clinically relevant spatial resolution. In this work, we propose the use of a stack-of-stars radial acquisition with a compressed sensing reconstruction for high spatial-temporal resolution breast DCE-MRI.

The goal of this thesis is to evaluate the spatial and temporal performance of the proposed approach under a broader range of imaging conditions (including the presence of cardiac and respiratory motion, varying tissue contrast kinetics, and different noise levels) to characterize the performance limits. Further, there is a need to validate the accuracy and robustness of quantitative pharmacokinetic parameter estimation using the proposed technique if this approach is to be used for quantitative DCE in clinical practice.