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Comparison of ADMM and NLCG reconstruction in DCE MRI

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Motivation & Introduction

In accelerated Dynamic Contrast Enhanced(DCE) MRI, Compressed Sensing(CS) and parallel imaging techniques are used to achieve higher acceleration rate to realize better spatial and temporal resolution. Due to the large size of the data, reconstruction time is critical. Augmented Lagrangian (AL) methods proved to be a powerful tool to accelerate constrained reconstruction problem by splitting variables and introducing dummy variables. In this study, Alternating Direction Method of Multipliers (ADMM) is used in DCE MRI reconstruction and shows better and faster reconstruction results comparing to conventional non-linear conjugate gradient(NLCG) in both retrospective and prospective accelerated MRI data sets.

Experiments

A fully sampled DCE data set from clinical scan is retrospective undersampled 35x times using Poisson-disc random sampling. Both ADMM and NLCG are used to reconstruct the data set with same constraint penalty to compare the speed and the image quality. The data is acquired from a 3T GE HDxt scanner, with matrix size 256*186*10*35*8(kx*ky*kz*nt*coils). Both ADMM and NLCG use wavelet, TV(total variation) and a linear temporal filter as the constraints. The penalties for these three constraints are 1e-4, 1e-4 and 1e-2 respectively. Figure 1 shows selective reconstructed slices in ADMM and NLCG.
Figure 2 shows MSE and MSSIM performance through time

Discussion & Future Work

In this study we demonstrated a faster and better reconstruction algorithm to reconstruct highly accelerated DCE data sets. Yet the actual speed varies a lot in different machine environment, and it is also affected greatly by different coding efficiency. A further detailed analysis of the calculation between the algorithms is needed. A test in a actual higher dimension clinical data sets with prospective undersampled scheme is undergoing as well.
Furthermore, the MSE and MSSIM results can show the image quality in some degree, but a task-based image metric is needed to accurately determine the image quality for different clinical setting.

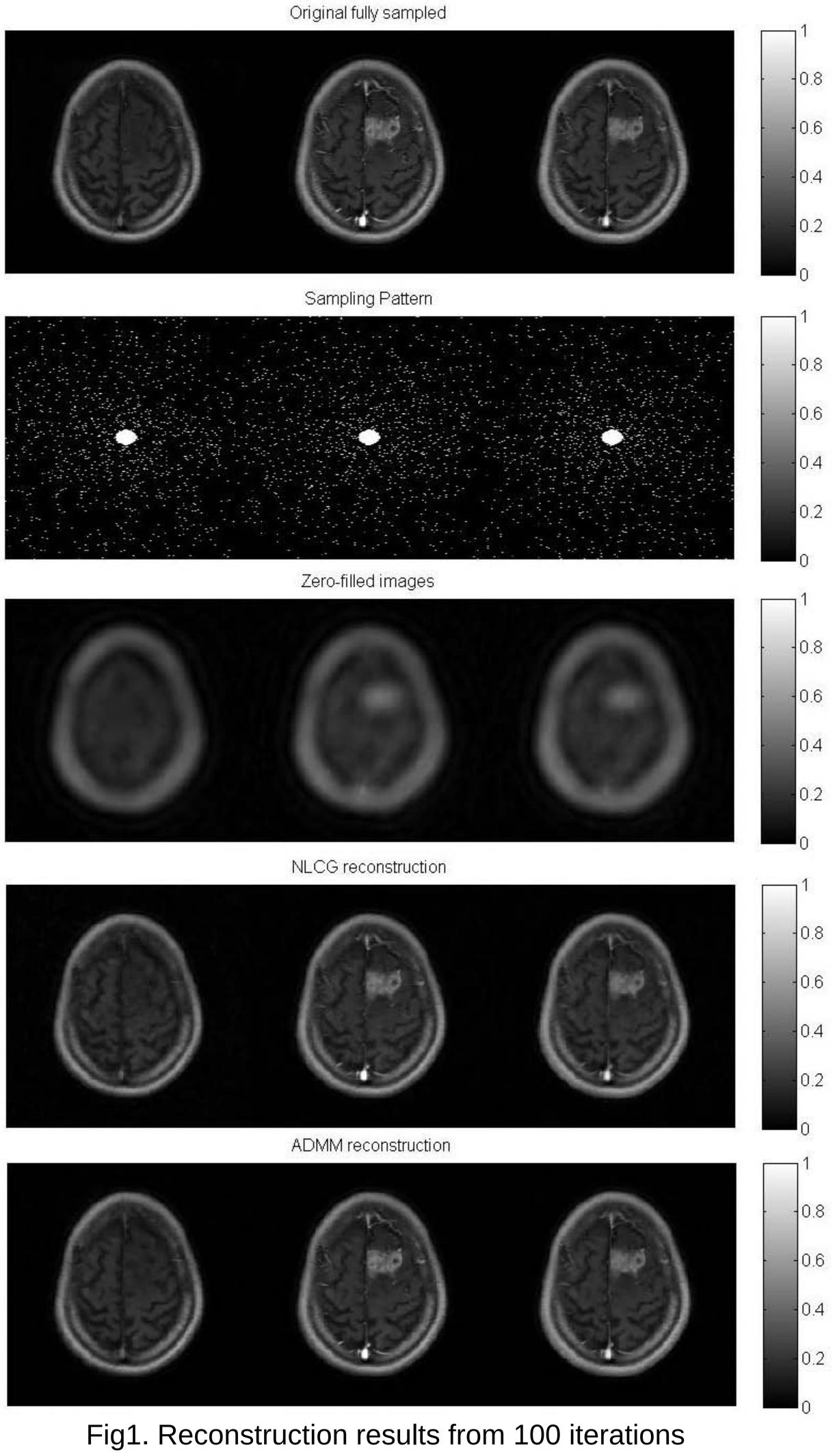

Fig1. Reconstruction results from 100 iterations

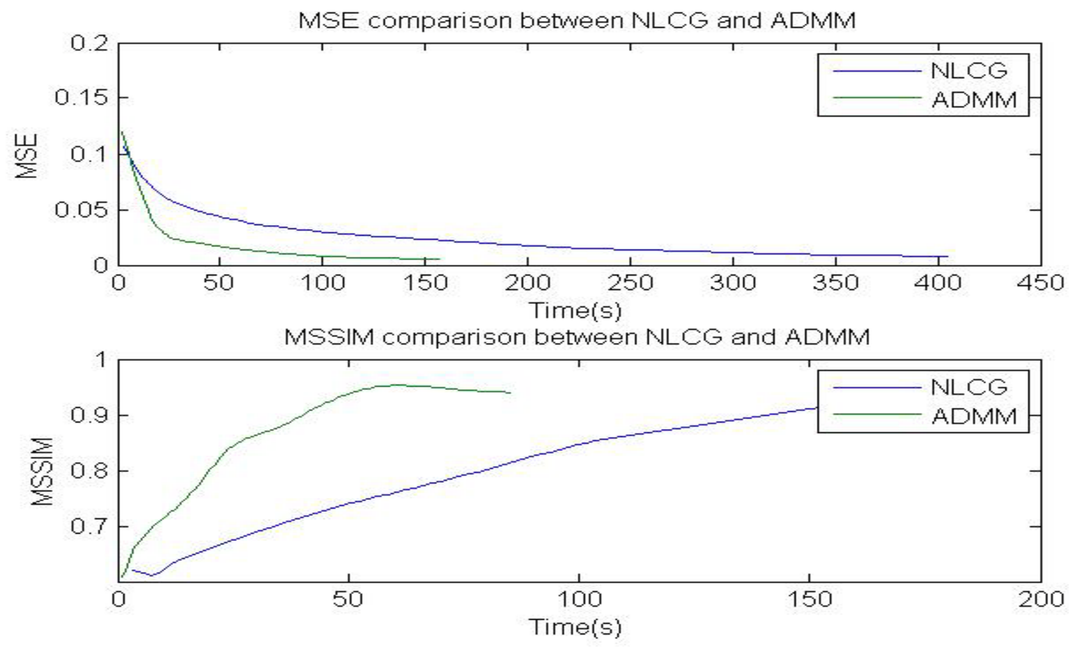

Fig2. Comparison of MSE and MSSIM against time

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