Parallel Generalized Series Imaging

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SYNOPSIS

Many imaging applications require collecting a time series of images. Conventional methods acquire these images independently, leading to a trade-off between spatial and temporal resolution. To address this problem, this paper presents a novel algorithm to integrate generalized series imaging with parallel imaging using multiple receiver coils. Experimental results from contrast-enhanced MRI studies demonstrate that the proposed algorithm can produce high-quality dynamic images with large acceleration factors.

INTRODUCTION

Parallel Imaging: Parallel imaging using multiple receiver coils is emerging as a powerful tool for fast imaging [1,2]. With $L$ receiver coils for sensitivity-encoding (SENSE), it is possible to undersample $k$-space by a factor of $R \leq L$, thereby increasing imaging speed by a factor of $R$. Image reconstruction in SENSE is often accomplished by solving a matrix equation [2]. In practice, errors in both the estimated coil sensitivity functions and the measured $k$-space data can lead to significant reconstruction errors when the matrix equation is ill-conditioned. This problem can be effectively addressed using the method proposed in this paper.

Generalized Series (GS) Imaging: GS imaging is characterized by the acquisition of one (or a few) high-resolution reference image(s) and a sequences of reduced dynamic data sets [3]. The reference image(s) is used to construct an optimal set of basis functions for reconstructing high-resolution dynamic images from a small number of dynamic encodings. More specifically, each dynamic image is expressed by: $\rho x = \rho x_0(x) + \rho x_1(x) + \cdots + \rho x_L(x)$, where $\rho x_i(x)$ is the $i$-th dynamic image.

RESULTS

The proposed method has been tested using sensitivity-encoded data from contrast-enhanced experiments. A set of representative result is presented in Figure 2, which shows that the proposed algorithm can generate high-quality dynamic images with large acceleration factors.

CONCLUSION

This paper presents a novel algorithm to integrate generalized series imaging with sensitivity-encoded parallel imaging using multiple receiver coils. This algorithm takes advantage of both the conventional parallel data acquisition scheme and the GS model-based reduced-scan imaging method to achieve high spatiotemporal resolution in dynamic imaging. The proposed algorithm has been validated using experimental data from dynamic contrast-enhanced MRI experiments, which produced excellent results. We expect the algorithm to be useful for a number of dynamic imaging applications.

REFERENCES