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Undersampled phase-contrast imaging of the carotid arteries

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Introduction

For dynamic MRI, in order to balance the tradeoff between spatial resolution and temporal resolution, one strategy is to reduce data sampling at every time frame and add constraints to compensate for the information loss [1-4]. Here a temporal constraint was applied to reconstruct the carotid artery velocity over time. Undersampled data was simulated by omitting lines in the PE direction. Different forms of a temporal TV constraint were compared here, and projection onto convex sets (POCS) was used to reconstruct the dynamic MRI images.

Methods

Two types of POCS were used: serial POCS that the fidelity term projection and the temporal constraint projection were performed alternately to update the estimated images, and parallel POCS, that the projection terms were weighted to update the estimated images. Three forms of temporal constraints were applied: complex form, separate real and imaginary form, and magnitude form alone.

Three subjects were tested. Results from one of the subjects with a thirty time frame (cardiac phases) 2D MRI GRE phase contrast acquisition of 512*256 with venc = 0 and venc = 150 cm/sec are shown. An undersampled pattern of interleaved PEs in the outer k-space area (one in every six PE lines were sampled) and full-sampled in the k-space center (26 PE lines) was used to simulate the undersampled data. This gave an overall acceleration factor of R = 4. All constrained methods were initialized using a "sliding window" method that replaced unmeasured k-space locations with their neighbor nearest in time.

Results

The velocity-time curve of one dataset is shown in Figure 1. Undersampled phase images reconstructed using different temporal TV constraints are shown in Figure 2.

Conclusion

The complex temporal TV constraint gave better results than the sliding window method; separate real and imaginary temporal TV and magnitude temporal TV alone did not give good results.

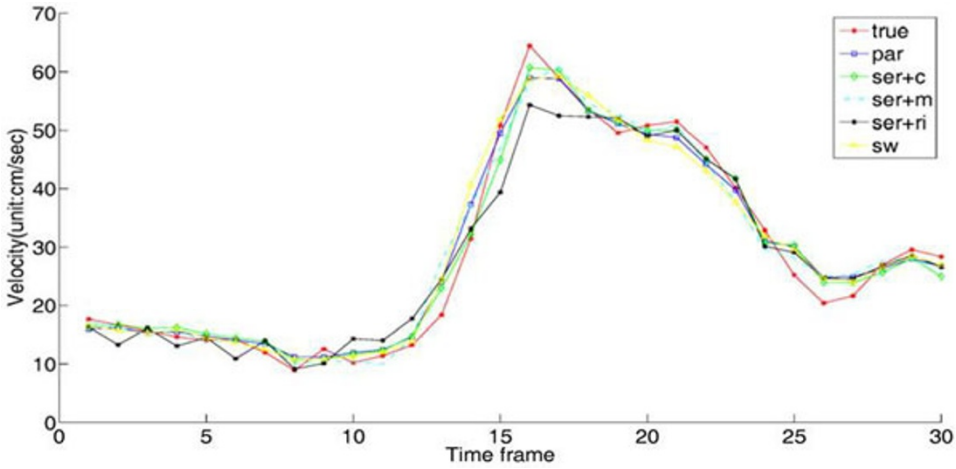

Figure 1
The velocity-time curve from a region of interest on the internal carotid artery using differenct reconstruction methods: parallel POCS with complex (blue), serial POCS with complex (green), magnitude (light blue) and separated real and imaginary (black) and sliding window (yellow). The red curve indicates the velocity measured from full k-space.

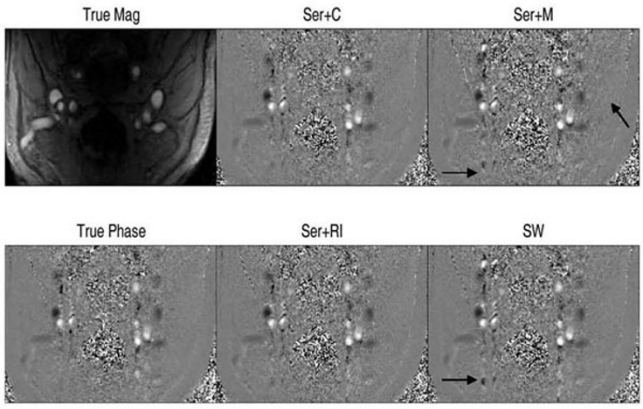

Figure 2
Undersampled phase contracts images reconstructed using different temporal TV constraints; serial complex (Ser+C), magnitude (Ser+M), separate real and imaginary(Ser+RI) and sliding window(SW). The left column shows the full sampled magnitude(True Mag) and phase(True Phase) images. The arrows indicate aliasing artifacts.

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