

VIBE with Projections Onto Convex Sets (POCS) for Abdominal Imaging

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Introduction

Abdominal imaging requires short scan times for breath holding, particularly in ill patients. Volumetric Interpolated Breath-hold Examination (VIBE) [1] is routinely used for dynamic contrast enhanced imaging of the abdomen. To cover the liver and kidneys, typical VIBE imaging requires approximately 20 seconds. In ill patients, breath hold times must be minimized to avoid artifacts and maintain patient comfort. Reversed asymmetric echo acquisition at opposed phase TE can reduce scan times while maintaining uniform fat suppression [2]. To further reduce scan time, phase partial Fourier is often employed. However, echo asymmetry and phase partial Fourier with zero filling cause blurring artifacts in the in-plane view. This abstract describes the use of phase correction with projection onto convex sets (POCS) [3] to the VIBE sequence in order to reduce blurring artifact and improve image quality at short scan times.

Method

VIBE was acquired on a 1.5T MAGNETOM Espree (Siemens Healthcare USA, Malvern, PA) with Total Imaging Matrix six element body matrix coil and six to nine elements of the spine matrix coil. 6/8 partial Fourier was used in the phase and slice directions. POCS was applied in the phase-encoding and readout directions. Additional parameters included 320 base resolution, TE = 2.4 ms, TR = 4.3 ms, reversed asymmetric echo, FOV = 300-380 mm, phase FOV = 80-90%, partition thickness = 3-4 mm, slices per slab = 56-72, slice resolution = 64-67%, flip angle = 10°, bandwidth = 360-390 Hz/pixel, and iPAT parallel imaging (GRAPPA) with acceleration factor = 2 in the phase encoding direction. Quick-Fatsat was used for fat suppression. For comparison, VIBE with similar parameters was run with symmetric echo and no phase partial Fourier. Ten patients were scanned for the study.

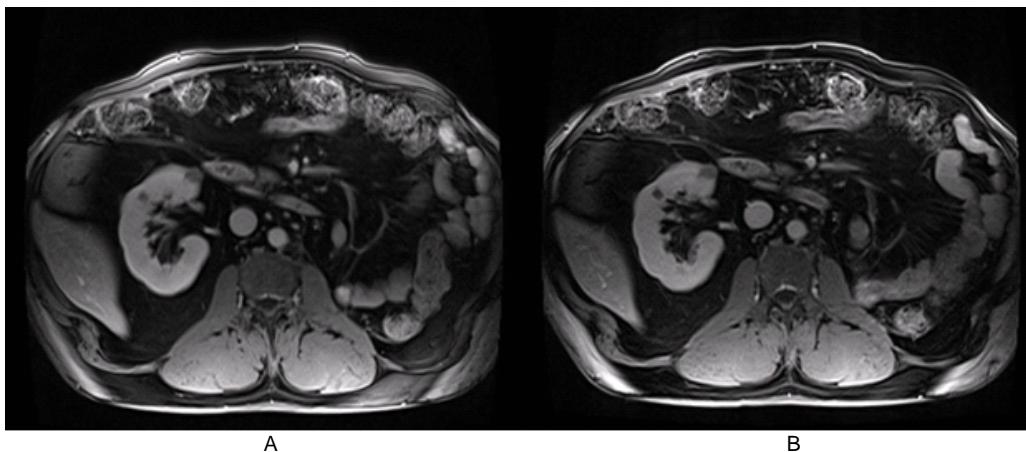


Figure 1. (A) Standard VIBE at 320 base resolution with symmetric acquisition and no phase partial Fourier. (B) VIBE acquired with reversed asymmetric echo, 6/8 phase partial Fourier, and POCS in the phase-encoding and readout directions. Scanning time in (B) was 6 seconds shorter than (A), and (B) demonstrates excellent image quality comparable to (A).

Results and Discussion

Addition of 6/8 partial Fourier and reversed asymmetric echo to VIBE results in a significant scan time reduction (6 seconds in the example of Figure 1). With current gradient systems, addition of these parameters allows VIBE acquisition at 320 base resolution in less than 15 seconds, increasing the likelihood of successful breath-holding and artifact-free imaging. POCS phase correction prevents partial Fourier blurring and yields a net improvement in image quality over standard zero-filling. As seen in Figure 1, images with POCS phase correction are as good as images obtained with symmetric echo and no phase partial Fourier. From previous literature [3], POCS reduces the SNR and may cause ringing in gradient echo imaging, but neither was seen in this case. Furthermore, combination of POCS and iPAT parallel imaging in the same phase encoding direction does not cause artifacts. In conclusion, POCS in combination with the above parameters maintains VIBE image quality despite reduced scan times.

References

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