Parallel Imaging Method for Split-Blade PROPELLER DWI

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Introduction

PROPELLER [1] and Turbo-PROP DWI [2] have shown advantages over traditional EPI DWI with high resolution, benign behavior of motion artifacts, and robustness to off-resonance. A split-blade approach [3] is often applied to meet the non-CPMG conditions and make PROPELLER DWI generally applicable to receive-only coils. However, the width of PROPELLER blade is reduced in this approach, making it less robust to motion. Parallel imaging techniques are applied in this work to effectively widen the PROPELLER blade, thus reducing motion artifacts and improving image quality.

Methods

We implemented a "Mutual-Calibration" method, which is similar to [4]. This algorithm (as seen in Figure 1) is a k-space parallel imaging reconstruction method. Odd and even echoes form the horizontal and vertical blades, respectively. There is no motion between these two blades since they are acquired during the same echo train. Therefore, they provide excellent calibration data for each other. With this technique, all data are self-calibrated and there is no need for additional ACS data. The prescribed acceleration factor is the "true" acceleration factor. Hence, this "mutual-Calibration" method is especially suitable for PROPELLER split-blade DWI.

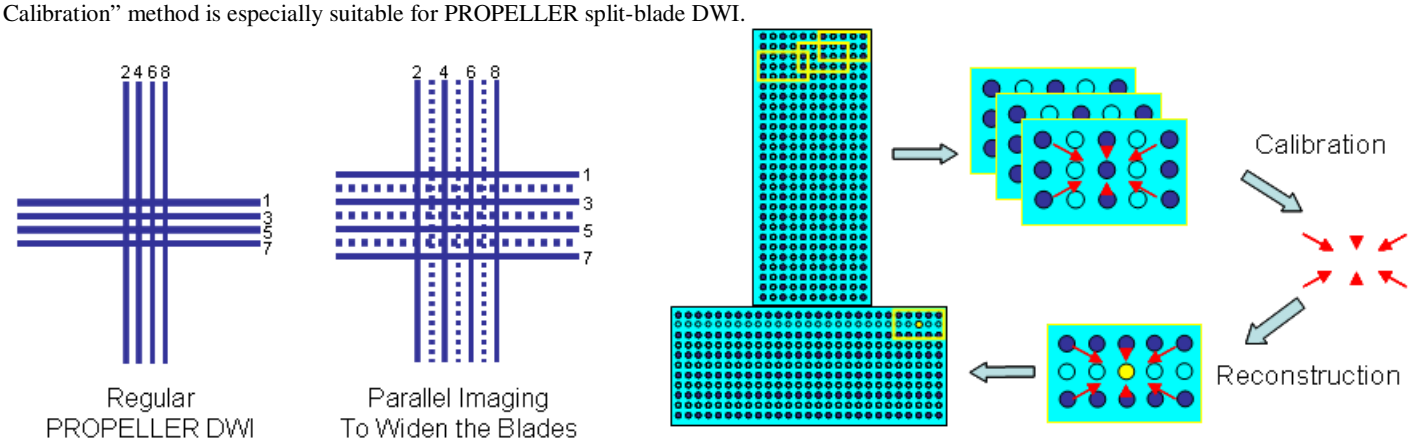

Figure 1. The "mutual calibration" parallel imaging method for the PROPELLER DWI. The blue points represent the acquired k-space data, the blank points represent the missed k-space data, and the yellow points represent the reconstructed data. Coil coefficients are represented by the red arrows.

Experiments and Results

Turbo-PROP DW Images of a healthy volunteer's brain were acquired on a GE SIGNA 3T scanner with an 8-channel receiver-only brain coil. As seen in Figure 2, this "mutual-calibration" method could effectively remove the aliasing artifact. In Figure 3, we compare the results of regular split-blade DWI (NEX = 3) and split-blade DWI with parallel imaging (NEX = 1.7, acceleration factor = 2). No obvious difference was observed besides the SNR difference.

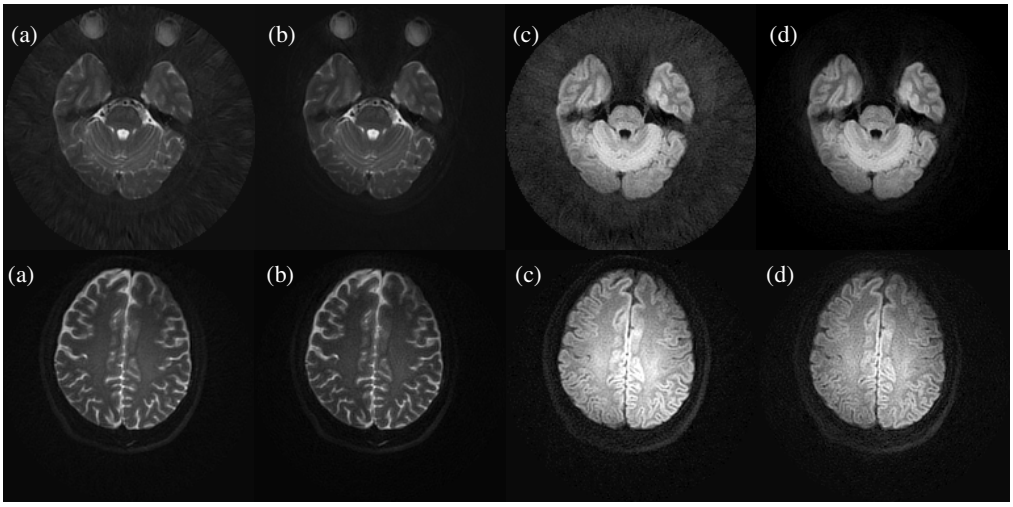

Figure 2. Data were acquired with R = 2, and images were reconstructed with (b,d) and without (a,c) parallel imaging techniques, for b = 0 (a,b) and b = 1000 (c,d) images.

Figure 3. Images acquired with regular split-blade method (NEX = 3) (a,c) and split-blade with parallel imaging technique (NEX = 1.7, acceleration factor = 2), for b = 0 (a,b) and b = 1000 (c,d) images.

References:

[1] Pipe JG, et al, MRM (47), 42-53, 2002.
[2] Pipe JG, et al, MRM (55), 380-385, 2006.
[3] Pipe JG, 2003 ISMRM Proc, p. 2126
[4] Blaimer M, et al, 2006 ISMRM Proc, p. 5.

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