# ADAPTIVE 2D CENTRIC VIEW ORDERING FOR FAST ABDOMINAL IMAGING

**E. Bayram[1], C. R. Michelich[1], A. T. Vu[1], J. H. Akao[1], S. Chang[1], S. M. Joshi[1], R. F. Busse[2], A. C. Brau[3], P. J. Beatty[3], and L. Estkowski[1]**

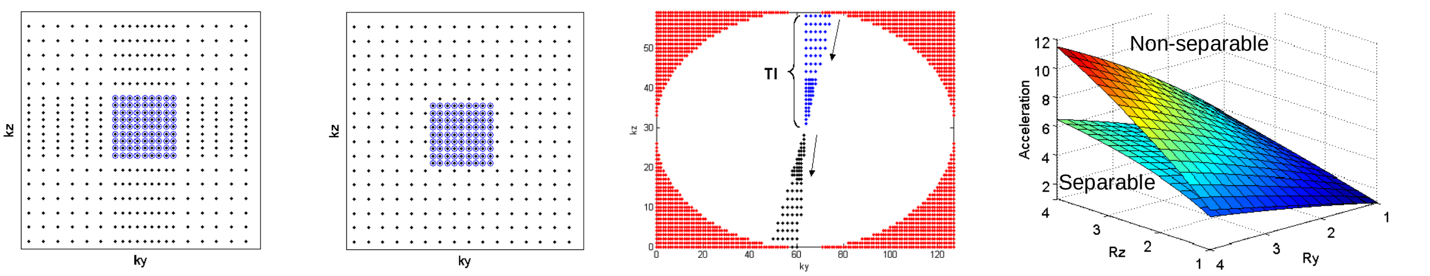
[1]MR Engineering, GE Healthcare, Waukesha, WI, United States, [2]Global Applied Science Lab, GE Healthcare, Madison, WI, United States, [3]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States

**INTRODUCTION:** Resolution and coverage in abdominal MRI are largely limited by the breath-hold scan times. 2D parallel imaging can be utilized to address this issue [1,2,3]. The potential for breath-hold mismatch between the external calibration scan and the accelerated scan makes self-calibrated techniques more appealing, at the expense of reduced net acceleration. The scan time penalty becomes even more evident with magnetization-prepared fat suppression approaches in which a segmented view-ordering scheme must be employed. Segmentation forces the number of total views along the segmentation direction to be an integer multiple of the segment size and also to remain constant from one kx-ky or kx-kz plane to the next. This restriction forces the acquisition to fall on a separable ky-kz grid as shown in Fig.1A. An adaptive centric view ordering scheme is proposed that supports more efficient sampling patterns including non-separable grids such as the one shown in Fig.1B as well as k-space corner removal [4].

**METHODS AND MATERIALS:** The proposed approach treats segmentation as a 2D problem in ky-kz rather than a 1D problem along ky or kz. The proposed technique assigns all views to segments based on angle, and splits each segment into two subsets: the first group traverses to the k-space center in descending distance order with respect to ky-kz origin and is collected right after magnetization preparation pulse, whereas the second group traverses from the k-space center in ascending distance order. Fig 1C demonstrates a sample segment acquisition with a 2x2 accelerated non-separable sampling combined with 22% k-space corner removal. Inversion time (TI) dictates the size of the first set, while the desired fat suppression efficiency dictates the segment size. The benefit of the new non-separable view order on net acceleration is even more evident at higher outer acceleration factors, as shown in Fig1D.

Healthy volunteers were scanned on a 3T scanner (Signa® HDx, GE Healthcare, Waukesha, WI). Using an 8-channel cardiac coil, 2x2 outer acceleration with a matrix of 256x224x72 yielded 1.8x2.2x4.0mm$^3$ voxels before interpolation and required 25 seconds with the standard view ordering and 20 seconds with the new view ordering. Using a 32-channel torso coil, 3x3 outer acceleration with a matrix of 256x256x100 yielded 1.5x1.5x3.0mm$^3$ voxels before interpolation and required just 12 seconds for the new scheme.

**RESULTS and DISCUSSION:** Fig 2A and B show 2x2 acceleration with the old and new order, respectively**.** Fig 3 shows 3x3 acceleration: image A is a native axial slice, and B and C are the corresponding coronal and sagittal reformats, respectively. The new view ordering provides significant scan time saving via flexible segmentation and consistent fat suppression due to its 2D centric nature.




(A) (B) (C) (D)

**Fig 1:** A) 2D self-calibrated separable sampling: formed by two 1D accelerations in phase and slice directions. B) 2D self-calibrated non-separable sampling pattern: 2D acceleration outside calibration region (blue circles). C) Proposed segmented centric view ordering acquisition with 22% k-space corner removal. D) Increased net acceleration with the new view ordering, given a 256x60 prescription with 20x20 self-calibration region. Ry and Rz are phase and slice outer acceleration factors, respectively ranging from 1 to 4.

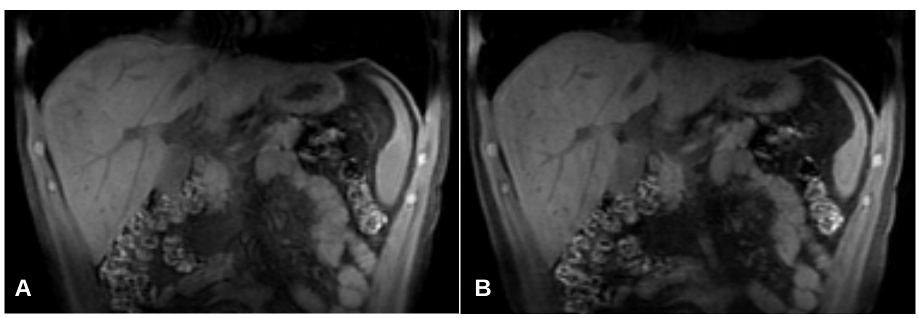



**Fig 2:** A) 25-second long separable 2x2 acceleration self-calibrated scan with 75% slice resolution. B) 20-second long non-separable 2x2 acceleration self-calibrated scan with same prescription parameters as A besides 78% k-space coverage with 22% corner removal is utilized instead of 75% slice resolution. Comparable image quality and fat suppression is observed with proposed scheme despite being 20% shorter acquisition.

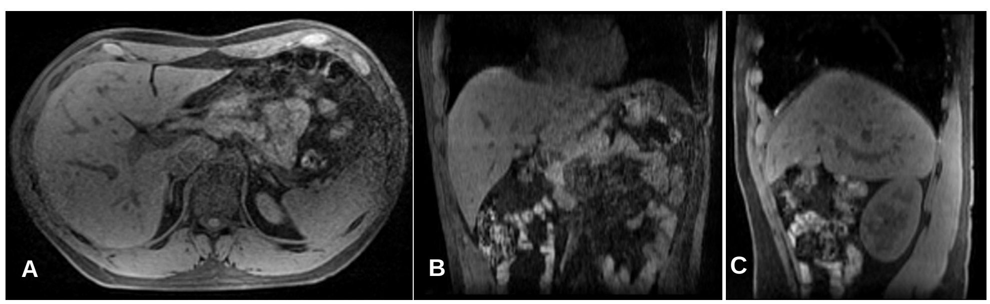



**Fig 3:** A) Native axial slice of a 12-second long 3x3 non-separable self-calibrated scan using a prototype 32-channel coil. Readout is placed in A/P. B and C are the coronal and sagittal reformats, respectively.

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