# Highly accelerated fMRI: a feasibility test of image support reduction technique

**F. Huang[1], H. Cheng[2], and Y. Li[1]**

[1]Advanced concept development, Invivo Corporation, Gainesville, FL, United States, [2]Imaging Center, Indiana University, Bloomington, IN, United States

***Introduction***:

Partially parallel imaging (PPI) has been recently applied to fMRI to reduce imaging artifacts or improve spatial resolution by under-sampling the k-space data [1]. However, its efficiency has been limited if the acceleration factor is not high [2]. At a high acceleration factor, the image quality may be considerably reduced and this may consequently degrade BOLD contrasts in fMRI time series. It has been reported that the image support reduction technique can be used to improve PPI performance for dynamic imaging at a high acceleration factor [3, 4]. This study aims to test the feasibility of the application of image support reduction technique in fMRI. Experimental results demonstrate that activation can still be accurately detected at acceleration factor as high as 4 with image support reduction technique.

***Method*:**

Full *k*-space data were acquired on a SIMENS 3T Trio scanner using a single-shot EPI pulse sequence (TR/TE = 2000/30 ms, Matrix size = 64×64×33×128). Block design visual stimuli were presented using a flashing checkerboard. To simulate the fast imaging, time interleaved *k*-space data were obtained by down sampling the full *k*-space by a factor of 4 and 6 and the artificially undersampled data were used for reconstruction. Similar to the method described in Refs [3, 4], average *k*-space data were generated from all the time frames. Residual *k*-space data were generated by the subtraction of the average *k*-space data from the acquired data. TGRAPPA [5] was used for reconstruction with the residual *k*-space data. The final reconstruction is the summation of results of residual *k*-space and that of the average *k*-space. Standard fMRI data processing was done in SPM5 for the full *k*-space data and the reconstructed data using image support reduction technique.

***Results***:

Fig. 1 shows one slice of the reconstructed images. The three images are from reference, and images with acceleration factor 4 and 6 respectively. It can be seen that the reconstructed images have similar SNR. Even when the acceleration factor becomes 6, the image (Fig. 1c) still have similar SNR and spatial resolution as the reference image. Fig. 2 shows the results from SPM5. From the comparison of active regions, it can be seen that the images reconstructed with acceleration factor 4 have similar active region as these of reference images. However, when acceleration factor goes to 6, the size of active regions is dramatically reduced. The number of activated voxels as a function of t-threshold is shown in Fig. 3. From full k-space (R = 1) to R = 4, the activation size decreases by about 20%, but further increase of acceleration factor results in significant loss of activation.

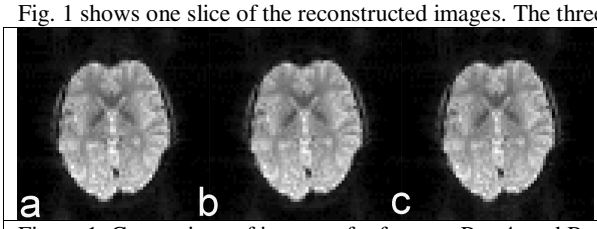


Figure 1. Comparison of images of reference, R = 4, and R = 6

***Discussion and Conclusion***:

In this work, image support reduction technique was applied to fMRI. The results with simulated fast imaging data show that image support reduction technique does not reduce temporal resolution much while preserve the SNR and spatial resolution. From the results of t-test, it can be seen that the active regions can be well preserved when acceleration factor goes to 4. Higher acceleration factor may reduce temporal resolution too much to reflect the active regions. In conclusion, image support reduction technique is applicable for fMRI to achieve higher spatiotemporal resolution. Further test with true acceleration set is necessary to demonstrate the efficiency of image support reduction technique.

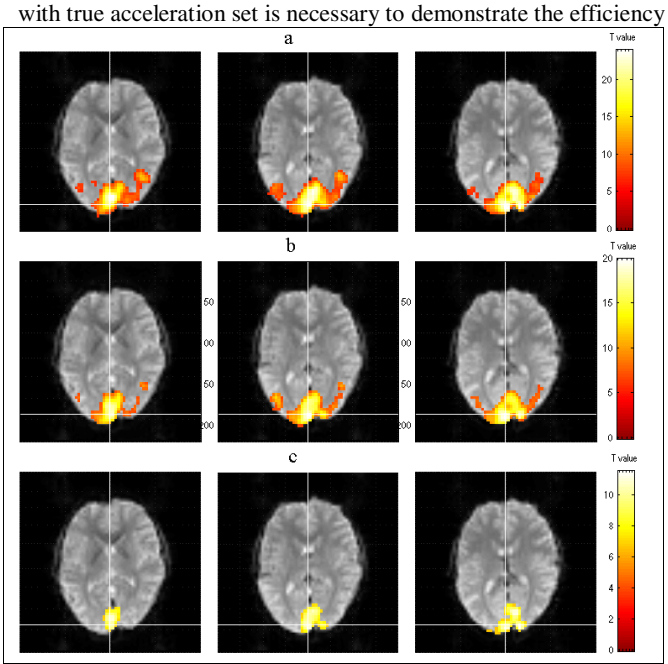


Fig. 2 Results of t-test. Active regions generated from the reference (a), images with R = 4 (b), and images with R = 6 (c)

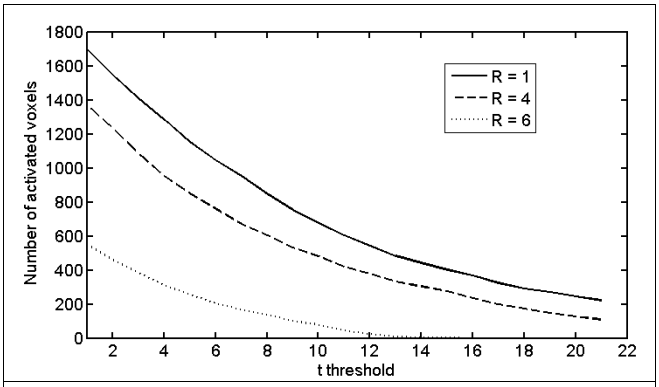


Fig. 3 Number of activated voxels as a function of t-threshold.

***Reference:***

[1] Bellgowan P, et al. NeuroImage 29: 1244-1251 (2006). [2] Speck O, et al., ISMRM, 2007: p691. [3] Huang F, et al. ISMRM, 2005, 2690; [4] Blaimer, M, et al, ISMRM, 2007:p749 [5] Breuer FA, et.al., MRM 2005;53:981-985