Motion Insensitive FSE for T2-Weighted Abdominal MRI

F. Sun[1], G. Cao[1], C. Liang[2]

[1]GE Healthcare Technology-China, Beijing, Beijing, China, People's Republic of, [2]Radiology Department, Guangdong provincial people's hospital, Guangzhou, Guangdong, China, People's Republic of

Introduction:

Multi slice T2 weighted FSE is the most commonly used sequence in abdominal imaging. Breath hold (BH) or Respiratory trigger (RT) is often used together with this sequence to suppress motion artifacts. Because RT method allows higher resolution than BH, therefore can detect small lesions better. However, severe motion artifacts sometimes present in RT FSE image for those patients with irregular respiratory cycle. In this paper we demonstrate a new phase encoding scheme for RT FSE sequence, which makes the FSE imaging less sensitive to motion.

Methods:

The old phase encoding scheme in RT FSE is that ky data is sampled linearly in an interleaved fashion for each echo train. It means that the adjacent ky views were acquired from different respiratory cycle with minimum of a few seconds time interval. When the respiratory cycle is irregular and sequence is triggered at a wrong time point, there could a big phase variation. When this phase variation fall into k-space center, a severe ghosting will appear. The new phase encoding scheme in the motion insensitive FSE (MI-FSE) is designed to reduce the phase variation in the k-space center. First it extracts the prescribed TE echo of each echo train group and fills them into the center of K space to make the image has sharp T2 contrast. Then, it fills each side of the center within one echo train group. This group has a duration of around 90ms, while the slow respiratory motion has a cycle of several seconds, therefore can be treated as motionless in terms of phase variation. The other lines of ky data were acquired in a segmented interleaved fashion except the central views. A scheme of the filling method was shown in Figure 1. Each group of ky lines, indicated by same color in Figure 1, were acquired linearly by one echo train. Even number of excitations (NEX) was used to allow linear-reverse phase encoding average to reduce the blurry caused by T2 decay. The experiments were performed on a GE 1.5T SIGNA Excite scanner (GE Healthcare Technologies, Milwaukee, WI, USA) use 8-channel phased array coil. The MI-FSE sequence has been tested on 12 volunteers with sequence parameters: matrix: 256*224, NEX: 2, ETL: 16.

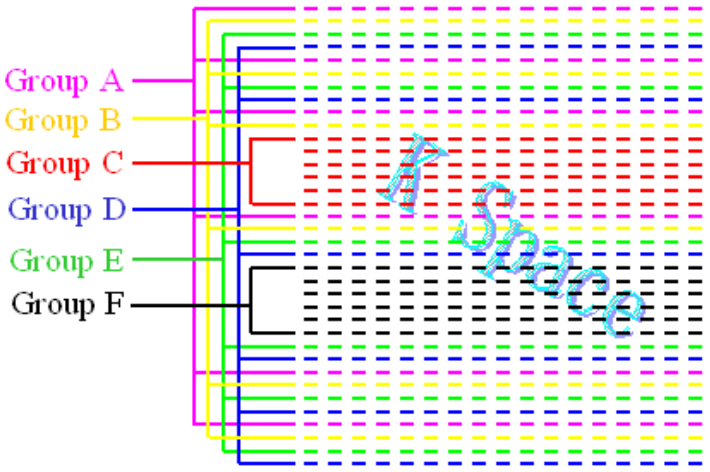


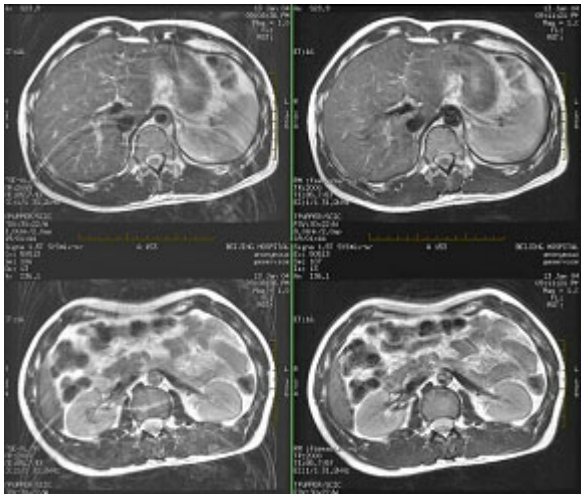
Figure 1: Schematic diagram to show K-space segmentation in MI-FSE sequence

Results:

Figure 2 demonstrated a motion sensitivity comparison between conventional FSE and MI-FSE. Both scans were performed when volunteers were free breathing without respiratory trigger to simulate the worst scenario. Conventional FSE images on left column showed much more motion artifacts than MI-FSE on the right, which proves that MI-FSE is truly in sensitive to motion. Figure 3 shows a typical example of MI-FSE scan with fat saturation and respiratory trigger, no motion artifacts exhibited in these images.

Conclusion:

This new K-space filling method appears to be effective in reducing motion artifacts. Continuing work will include more patient evaluation and quantitative measurement in the reduction of motion artifacts.



(a) Conventional FSE (b) MI-FSE

Figure 2: a comparison T2 scan without a respiratory trigger. (a) Images acquired using conventional FSE; (b) Images acquired using MI-FSE.

Figure. 3: An example of MI-FSE imaging with respiratory trigger and fat saturation.