

## PROPELLER EPI: Application to ASL Perfusion Imaging using FAIR

F-N. Wang<sup>1</sup>, T-Y. Huang<sup>2</sup>, T-C. Chuang<sup>3</sup>, C-Y. Chen<sup>4</sup>, H-W. Chung<sup>3</sup>, and K. K. Kwong<sup>5</sup>

<sup>1</sup>Institute of Brain Science, National Yang-Ming University, Taipei, Taiwan, <sup>2</sup>Department of Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, <sup>3</sup>Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan, <sup>4</sup>Radiology, Tri-service General Hospital, Taipei, Taiwan, <sup>5</sup>MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical imaging, Massachusetts General Hospital, Charlestown, Massachusetts, United States

### Purpose

Recently, PROPELLER EPI has been demonstrated in diffusion imaging with reduced susceptibility distortions [1,2]. In this study, we further explore the feasibility of PROPELLER EPI in perfusion imaging using the arterial spin labeling (ASL) techniques. Blood flow can be measured by the pulsed ASL method, such as the Flow-sensitive Alternating Inversion Recovery (FAIR) method [3,4]. Here, we use the PROPELLER EPI to acquire T1-weighted spin echo image after the inversion recovery preparation in the FAIR sequence in order to obtain a perfusion images with reduced geometric distortion.

### Materials and Methods

Three normal subjects were scanned for the perfusion map using the FAIR prepared magnetizations followed by the PROPELLER EPI acquisition on a 3T scanner (Achieva, Phillips, Eindhoven, Netherlands) with a 4-channel head array. The imaging parameters were TE/TI/TR=17/1000/2000 ms, Matrix size 128x128, FOV = 240 mm, NEX = 16, and the SENSE factor = 2. A total of 14 blades were acquired to combine one PROPELLER EPI image, and each blade has 32 phase encoding lines using spin echo EPI. The angle between the consecutive blades was 28 degrees. After applying the image reconstruction scheme [1], relative cerebral blood flow (CBF) maps were obtained by subtracting the slice-selective inversion images with non-selective inversion images

### Results

Fig.1 (a) and (b) show the slice-selective inversion image and the non-selective inversion image acquired using FAIR PROPELLER EPI respectively. Subtracting these two images, a relative CBF map with high gray matter (GM)/ white matter (WM) contrast was obtained (Fig. 1(c)). It is noted that these T1-weighted images (Fig. 1(a) and Fig. 1(b)) and the corresponding CBF map have reduced distortion, a feature of PROPELLER EPI technique.

### Discussion and Conclusion

The PROPELLER EPI can be used to acquire images with reduced geometrical distortion. The weakness of this technique is the extra time required for acquiring multiple blades. Nonetheless, by the nature of PROPELLER technique, the over-sampled k-space center increases the SNR of combined image. Due to the low sensitivity of ASL images, substantial averages are needed for subtracted perfusion map when using conventional ASL sequences. Therefore, we can acquire multiple blades instead of multiple NEX to achieve high SNR and distortion-free combined image simultaneously. An additional advantage of PROPELLER EPI is the feasibility of a shorter TE and hence a higher SNR, because of the shorter echo train length of each blade, which can also be utilized to acquire more slices with one IR preparation. In conclusion, our results showed the ability of PROPELLER EPI to acquire ASL images with high SNR, image contrast, and a reduced distortion. We expect that the PROPELLER EPI can be combined with other advanced ASL techniques.

### References

- 1.Wang FN, et al., MRM 54:1232-40,2005.
- 2.Chuang TC, et al. MRM in publish.
- 3.Kwong KK, et. al. MRM 34:878-87,1995.
4. Kim SG, MRM 34:293-301,1995.

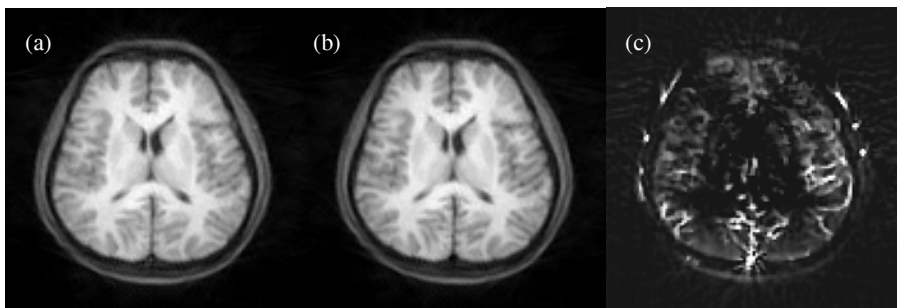


Figure 1. A selective IR PROPELLER EPI (a), a non-selective IR PROPELLER EPI (b) and a subtracted perfusion image (c). Note that the images are all with minimal geometrical distortion and high GM/WM contrast (c).