

MEETING ABSTRACT

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Highly accelerated Point-Spread Function mapping based on Finite Rate of Innovation for EPI distortion correction

Rita G Nunes^{1,2*}, Joseph V Hajnal^{2,3}

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¹Institute of Biophysics and Biomedical Engineering, Faculty of Sciences, University of Lisbon, Lisbon, Portugal

Hybrid MR-PET scans enable acquisition of both types of images within a session. Despite consistent subject positioning, image alignment can still be challenging. Functional MR images rely on echo-planar imaging (EPI) and present geometric distortions due to static B₀ field inhomogeneities. Direct B₀ [1] and Point Spread Function (PSF) mapping [2] (Figure 1) have been proposed for distortion correction. The PSF method is more robust [3], but acquisition times are long even with previous acceleration approaches [4-7].

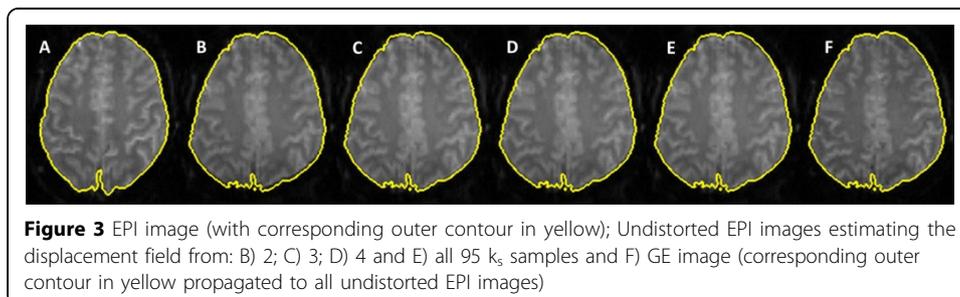
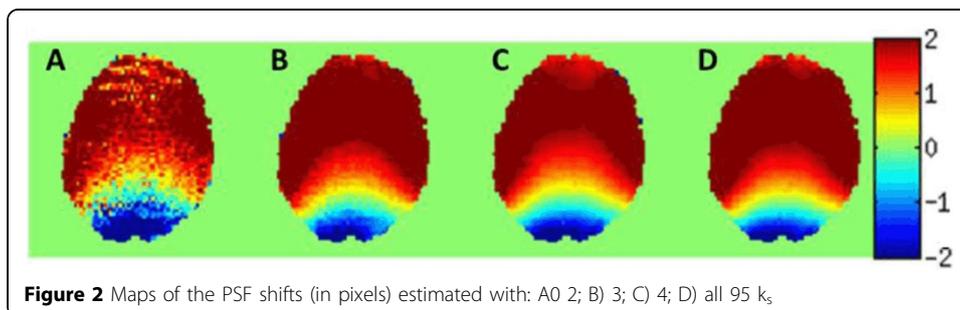
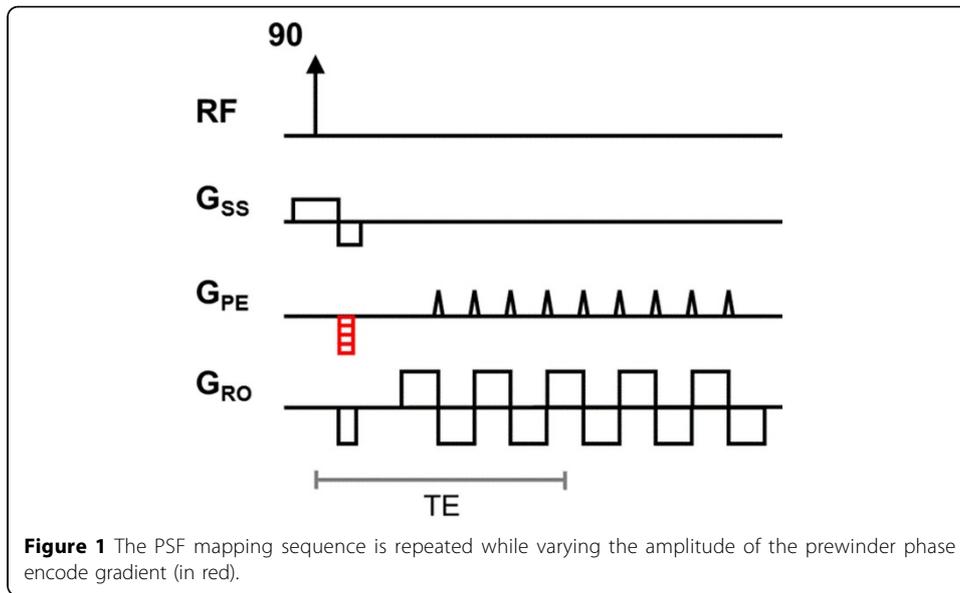
We used the Finite Rate of Innovation (FRI) framework [8,9] to detect the PSF peak position to sub-pixel precision using as few k_s samples as possible.

Images were acquired on a 3.0T Philips Achieva: $2.5 \times 2.5 \times 4.0$ mm³, matrix 96×95 , 95 k_s steps with under-sampling retrospectively performed. PSF peak position was estimated using both the fully-sampled (zero-filled by a factor of 1000) and highly-under-sampled data.

To determine the PSF peak location, pattern matching was performed. The signal measured at each spatial location was compared to a predicted signal pattern accounting for the k_s sampling scheme and the search progressively refined up to the intended precision. EPI images were undistorted as in [10].

Figure 2 shows example PSF peak shift maps (relative to expected undistorted positions). Figure 3A shows the original EPI slice matching Figure 2, and Figures 3B-E show the corrected images using each displacement map. Comparison with the GE image (Figure 3F) confirms accurate geometrical corrections.

Using the proposed approach the position of the PSF peak can be estimated from a very small number of samples. In the future distortion map estimation could easily be incorporated into standard preparation phases. Making distortion correction of EPI images more practical would facilitate combining functional PET and MR information as well as structural connectivity information from diffusion-weighted MR images.



Authors' details

¹Institute of Biophysics and Biomedical Engineering, Faculty of Sciences, University of Lisbon, Lisbon, Portugal. ²Division of Imaging Sciences and Biomedical Engineering, King's College London, London, UK. ³Centre for the Developing Brain, King's College London, London, UK.

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