Sensitivity-Encoded (SENSE) fMRI in the Medial Temporal Lobe

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INTRODUCTION

Initial studies demonstrated the potential of parallel imaging (PI) techniques for fMRI: for artifact reduction [1], gradient acoustic noise reduction [2] and achieving high spatial resolution [3,4]. Susceptibility artefact reduction is beneficial for studies exploring higher cognitive functions, which are known to involve regions severely affected by susceptibility heterogeneities. However, compared to full Fourier encoding, PI acquisitions like with SENSE [5] provide less SNR and exhibit spatially varying noise enhancement [5], which especially deteriorates functional signal stability within the medial temporal lobe. This study therefore investigates, whether SENSE is advantageous for fMRI in the medial temporal lobe, and if so, how different acceleration factors affect the fMRI group results.

METHODS

Measurement parameters:

- 3 T whole body system (Philips Intera), TR body coil, 8-element head receiver array (MRI Devices Corporation, Waukesha WI, USA)
- 31 slices, spatial resolution 2.75x2.75x4mm^3 (acq. matrix 80x80), FOV 220mm, TR 3s, TE 35ms
- conventional sshEPI vs. SENSE-sshEPI with R=2.0 and R=2.0 vs. R= 2.4, 2.7, 3.0 respectively
- two sex and agematched groups of 14 subjects each

Stimulus and Paradigm:

- face-profession learning task, block paradigm

Postprocessing:

- FEAT (FMRIB's Easy Analysis Tool) [6]: motion correction, high-pass temporal filtering
- Statistical analysis: FILM (FMRIB's Improved Linear Model) [6] with local autocorrelation correction, z > 3.5, cluster significance p = 0.01

RESULTS AND CONCLUSION

Susceptibility related image distortion was markedly reduced with SENSE- compared to conventional sshEPI (Fig. 1), however further improvements from high acceleration factors were only marginal and increasingly effected by noise enhancement (Fig. 2).

The face-profession learning task activated a network of regions including the medial temporal lobe (MTL), fusiform gyrus (FG) and inferior frontal gyrus (IFG). Group results revealed that the statistical power increased within the whole network with SENSE- compared to conventional acquisition. However, acquisition with high SENSE acceleration factors further increased statistical power only in the occipital lobe and fusiform gyrus, but not in the MTL, consistent with the increasing noise enhancement in this region. Surprisingly, at the highest SENSE factor, R=3.0, we again observed improvement of statistical power within the MTL. Additional experiments are needed to explain this phenomenon, and whether this effect might result from a residual foldover, warping occipital activation into the MTL. All observed trends were significant in a random effects analysis (z >2.3, p = 0.05).

We conclude that sshEPI with a moderate SENSE acceleration factor of R = 2.0 is well suited for the detection of medial temporal activation at 3T.

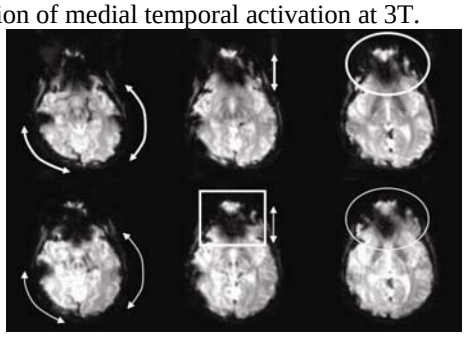

Figure 1: Sample conventional (top) and SENSE R=2.0 (bottom) sshEPI images.

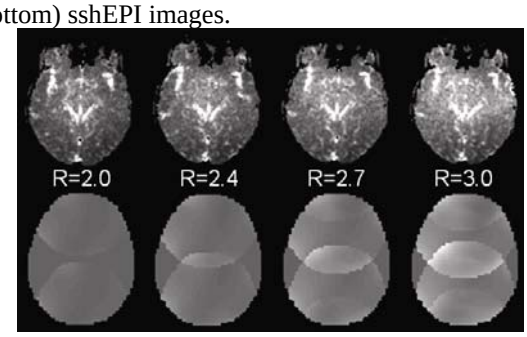

Figure 2: Increasing noise enhancement in the MTL with increasing SENSE acceleration factors. Top: noise maps (temporal signal fluctuations), bottom: g-maps.

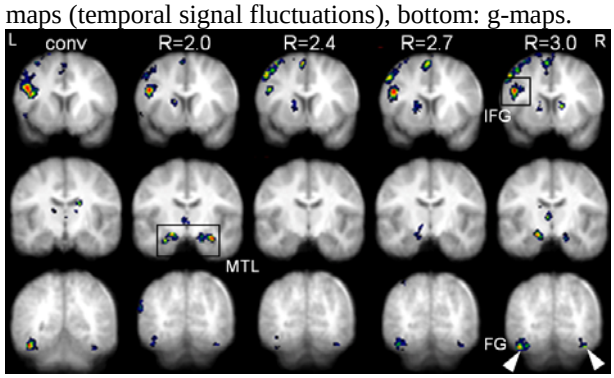

Figure 3: Group statistical maps showing activation in the IFG, MTL,FG for conventional and SENSE sshEPI.

REFERENCES

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