High Resolution Perfusion MRI using SENSE at 7T

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Introduction:

Spin-labeling perfusion imaging at high field poses unique requirements for the MRI acquisition technique. Because the perfusion contrast is based on subtraction of a labeled and a control scan, excellent temporal image stability is mandatory. However, techniques with excellent stability, such as single-shot EPI, often suffer from prohibitively large distortions at high field, in particular at high spatial resolution. Earlier studies have shown that the magnitude of these distortions can be reduced with accelerated imaging [1]. In the following, we used SENSE EPI to explore the practical spatial resolution limits for perfusion imaging at 7.0 T.

Materials and Methods:

MRI studies were performed on a 7.0 T GE MR scanner equipped with a detunable transmit coil and an 8-channel receive coil based on a gapped element design [2]. A FAIR spin labeling technique was implemented with the following parameters: TI=1.5s, TR=3.0s, slice thickness 2mm, selective inversion width 20 mm, scan time 6 minutes. SENSE rate 3 was implemented at various matrix sizes, the largest of these being a 144x108 matrix size for a 1.7 x 1.7 mm^2 nominal in-plane resolution. EPI readout time was 29 ms, TE 19 ms. A full field of view coil sensitivity reference scan was acquired separately, using the same EPI parameters with 3 interleaves. To reduce shot to shot phase instabilities, these were acquired with a TR of 100 ms and averaged over 20s.

Results:

The intrinsic image SNR at 7T proved adequate to obtain excellent quality perfusion images at 1.7 x 1.7 x 2.0 mm resolution. In grey matter, perfusion SNR ranged from 10-15. White matter perfusion was not detectable above noise level under these conditions. An example of a single axial slice at the highest resolution is shown in Fig. 1. The short 29 ms duration of the EPI readout allowed for minimal distortion in the brain regions studied, which were axial slices at or above the ventricular level.

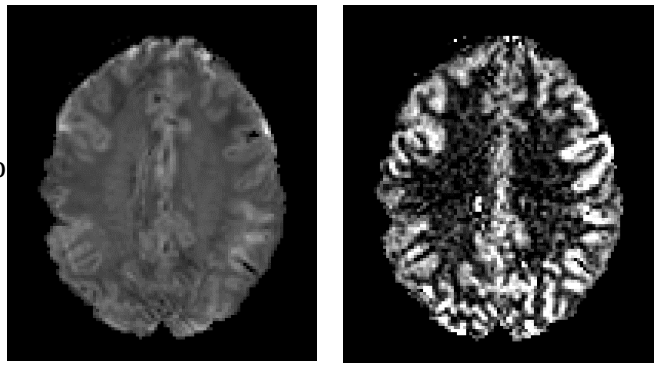

Figure 1. High resolution reference scan (left) and calculated perfusion image (right). Both images were intensity corrected (same correction) to compensate for the coil sensitivity variations inherent to array reception.

References: [1]. Bammer et al, Magn Reson Med **46**: 548, 2002; [2] de Zwart et al. Magn Reson Med **47**: 1218, 2002.