Highest resolution human in vivo brain MR imaging at 7T using prospective motion correction

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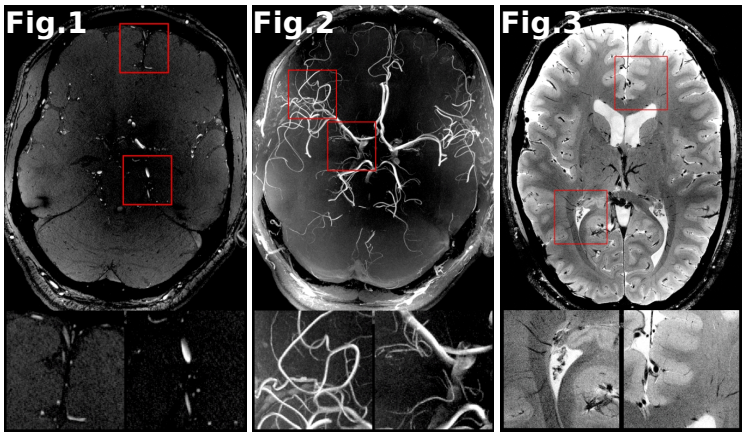
Purpose/Introduction:
Anatomical MRI brain imaging is widely used in Neurosciences. The high signal-to-noise ratio (SNR) of ultrahigh field MR scanners allows very high resolution imaging. This requires long acquisition times making it difficult even for co-operative subjects to hold their head still. Involuntary physiological motion like breathing and heartbeat [1] cause motion artifacts and a reduced effective resolution. In this work, we used an in-bore Moiré pattern based optical tracking system (MPT) to compensate for these motions and acquire artifact free ultrahigh resolution in vivo images from co-operative and trained subjects. This abstract focuses on the application of prospective motion correction for ultrahigh resolution in-vivo imaging in the human brain.

Subjects and Methods
All measurements were performed at 7T (Siemens, Germany) using a 32 channel head coil (Nova Medical ,USA). The MPT camera (Metria Innovation Inc., USA, [2]) was mounted in the scanner bore to track the marker attached to customized dental fixation. Cross calibration and real-time position update were performed according to previously described methods [3,4]. The motion compensated images shown in this abstract were acquired using a 0.12x0.12x0.6mm T2* 2D GRE (TR=900ms, TE=17.7ms, Averages=2, Total acq. time=51min) and a 0.2mm isotropic 3D TOF (TR=24ms, TE=6.52, Grappa factor=2, Averages=2, Total acq. time=57min) sequence. Other sequences such as 0.44 mm 3D isotropic T1-MPRAGE were also acquired successfully.

Results
TOF (Fig.1 / MIP: Fig.2) and GRE (Fig. 3) images were free from motion artifacts. Multiple averages ensured high SNR in the images but resulted in very long scan times. The MPT tracking system is sensitive and accurate enough to detect microscopic and physiological motion and apply motion correction in real-time.



Discussion/Conclusion
Head motion and physiological motion can be prospectively motion corrected and acquisition of ultra high resolution in vivo images becomes feasible. To avoid RF over-exposure and patient discomfort due to the long scan times, acquisitions without motion correction for comparison/demonstration were not acquired. The benefit of motion correction has been shown in several previous comparison studies [1,5] for lower resolutions, which suggests, that the improvement achieved by motion correction is even more dramatic for higher resolutions. To the authors' knowledge, the acquired images are the highest resolution in vivo human full brain ToF and 2D GRE images ever measured.

References
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