Project title: Dynamic field monitoring in ultra-high-field human MRI for the mitigation of hardware- and physiology-induced image artefacts.

Project leader: Benedikt A Poser, PhD

Function: Assistant Professor, designated PI MRI Methods

Collaborators: MR methods group, FPN

Proposal (250 words):

Introduction: Ultra-high MRI (≥7T) has become a pivotal technology in studying the brain, with many new insights continuously advancing our understanding of brain function, disease progression or new early biomarkers for prevention. This year, FDA and CE approval of the first commercial 7T human MRI paved the way for clinical use. While these most advanced MRI machines bring enormous potential for imaging at unprecedented resolution, contrast or speed, they also remain the most sensitive to imperfections in the magnetic field, the scanner hardware itself, motion, or field fluctuations caused by the patient inside – this severely limits practically attainable performance.
This problem is well-recognised with very active research going into several approaches. The most comprehensive is "dynamic field monitoring" which uses field sensors placed around the object (e.g. head) to measure the magnetic field in the target region with extreme spatial and temporal precision.
Hypothesis and Objectives: This information can, in principle be used for compensation of any kind of undesired fluctuations: post-hoc in specialised image reconstruction, or real-time feedback to the MRI system. Some good progress has been made, yet the techniques are in the infant stage with suitable solutions to "routine application" distinctly lacking.
Setting and Methods: The prospective PhD student will develop new but practicable correction methods on our 7T Siemens MRI, recently upgraded with Skope field-camera and dedicated receiver array; targeting both artefacts in anatomical MRI, and physiological signal corruption in functional MRI.
Impact: This project will greatly contribute to bringing 7T MRI to its full potential, and enhance its robustness in neuroscientific and clinical applications.

Requirements candidate: Highly motivated student with excellent programming and numerical skills, ideally with background in the computer or natural sciences; genuine interest to bridge the gap between fundamental development and application to the neurosciences. Good English communication skills and proactive and resolute attitude are required.

Keywords: ultra-high field, field monitoring, anatomical and functional MRI, motion correction, image reconstruction

Top 5 selected publications:

1. Priovoulos N, Jacobs HIL, Ivanov D, Uludag K, Verhey FRJ, Poser BA. High-resolution in vivo imaging of human locus coeruleus by magnetization transfer MRI at 3T and 7T. Neuroimage. 2017 (in press)

2. Poser BA, Setsompop K. Pulse sequences and parallel imaging for high spatiotemporal resolution MRI at ultra-high field. Neuroimage. 2017 (in press)

3. Tse DHY, Wiggins CJ, Poser BA. High-resolution gradient-recalled echo imaging at 9.4 T using 16-channel parallel transmit simultaneous multislice spokes excitations with slice-by-slice flip angle homogenization. Magn Reson Med; 201778:1050-1058. (9 citations)

4. Poser BA, Anderson RJ, Guérin G, Setsompop K, Deng W, Mareyam A, Serano P, Wald LL, Stenger VA. Simultaneous multislice excitation by parallel transmission. Magn Reson Med. 2013; 71: 1416-1427. (32 citations)

5. Barth M, Breuer F, Koopmans PJ, Norris DG, Poser BA. Simultaneous multislice (SMS) imaging techniques. Magn Reson Med. 2016; 75:63-81. (63 citations)