Project title: Improving the reliability of 7 Tesla clinical magnetic resonance imaging using optical motion tracking

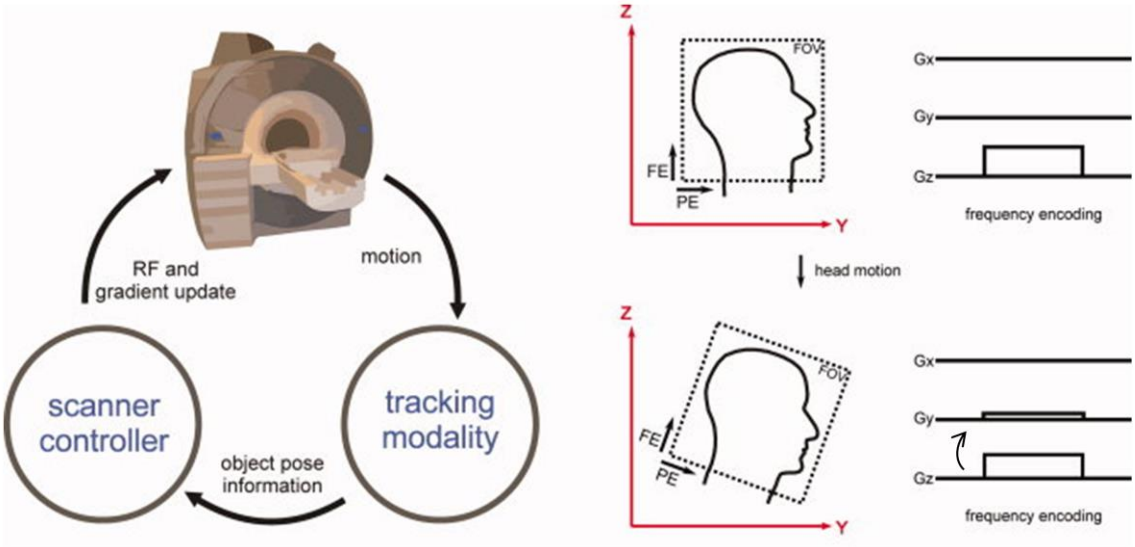
Project leader: Benedikt A Poser, PhD

Function: Assistant Professor, designated PI MRI Methods

Collaborators: Dimo Ivanov, PhD

Proposal (250 words):

Introduction: MRI at 7 Tesla allows to non-invasively map human brain structure and function with unprecedented detail and contrast, resulting in improved understanding of pathologies and the potential to identify biomarkers for and/or improve treatment of neurodegenerative diseases. In practice, the full potential of human MRI is rarely realized, especially in clinical application, because head motion precludes attaining the theoretical spatial precision or even renders images diagnostically worthless. Effective mitigation of motion artefacts remains one of the most important challenges in MRI methods development. One highly promising approach is to monitor the motion with a 'motion camera' and to correct for it by real-time scanner adjustment and special image reconstruction.



Source: Maclaren J, Herbst M, Speck O, Zaitsev M. Prospective motion correction in brain imaging: A review. Magn Reson Med. 2013; 69:621-36.

Hypothesis and Objectives: Integrating the optical motion camera with a suitably designed radiofrequency coil into the scanner's acquisition and reconstruction framework, will allow routine acquisition of clinical MRI data that greatly exceeds currently feasible quality.

Setting and Methods: All equipment including the Siemens whole-body 7 Tesla MRI scanner, Kineticor optical motion tracking and the dedicated radio-frequency receive coil is state-of-the-art and is available to this project. Real-time feedback of motion information from the camera to the scanner's hardware control will "lock" the measurement's coordinate system to the moving head.

Impact: The successful completion of this project will enable anatomical data of superior quality to be collected from elderly, children or patients who are simply unable to lie still. This will improve the diagnostic value, and help reduce burden on the patient due to re-scanning as well as the economic burden on the healthcare system.

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Requirements candidate: Highly motivated student with excellent programming and numerical skills, ideally with background in the natural sciences. Good English communication skills and proactive and resolute attitude are required.

Keywords: ultra-high field, anatomical MRI, neuroimaging, neurodegenerative diseases, Parkinson's patients, motion correction

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. Huber L, Ivanov D, Guidi M, Turner R, Uludağ K, Möller HE, Poser BA. Functional cerebral blood volume mapping with simultaneous multi-slice acquisition. Neuroimage. 2016; 125:1159-1168. (10 citations)

3. Ivanov D, Poser BA, Huber L, Pfeuffer J, Uludağ K. Optimization of simultaneous multislice EPI for concurrent functional perfusion and BOLD signal measurements at 7T. Magn Reson Med. 2017; 78:121-129. (8 citations)

4. Tse DH, Wiggins CJ, Ivanov D, Brenner D, Hoffmann J, Mirkes C, Shajan G, Scheffler K, Uludağ K, Poser BA. Volumetric imaging with homogenised excitation and static field at 9.4 T. MAGMA. 2016; 29:333-45. (10 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)