Erasmus MC / EUR CSC PhD 2014 Project Description

School / Department	The PhD candidate will be embedded in the Biomedical Imaging Group Rotterdam (BIGR), which is a technical institute within the Erasmus MC, university medical center, Rotterdam, the Netherlands.
Project Title	**Advanced reconstruction methods for quantitative MRI**

Abstract

Magnetic resonance imaging (MRI) is an extremely versatile medical imaging modality, which is of great value for clinical research and patient care. Dementia, cancer, and osteoarthritis are just a few examples of diseases where MRI plays an important role in the diagnosis, prognosis, or treatment monitoring. Traditionally, the images are assessed by qualitative, subjective, visual analysis. Nowadays, there is an increasing demand for more quantitative, objective, and automated analysis methods. With advanced image processing methods, quantitative imaging biomarkers can be extracted from the raw images. However, the current methods are often hindered by typical MRI artefacts, and there is a lack of insight in the effects of noise, acquisition settings, and patient motion on the accuracy and precision of estimated imaging biomarkers.

The aim of this project is to improve the quantification of imaging biomarkers, by gaining more control on the image formation and the image reconstruction process. To this end, the PhD candidate will develop and evaluate state-of-the-art MRI reconstruction methods. Knowledge of the MRI acquisition peculiarities (sources of noise, point spread function characteristics, magnetic field inhomogeneities) and prior information about the studied anatomy (tissue composition, typical organ movements) will be integrated in a unified model. One the one hand, this model should be exploited in the reconstruction process to improve image quality, and on the other hand, it will provide theoretical insight in the accuracy and precision of the estimated imaging biomarkers.

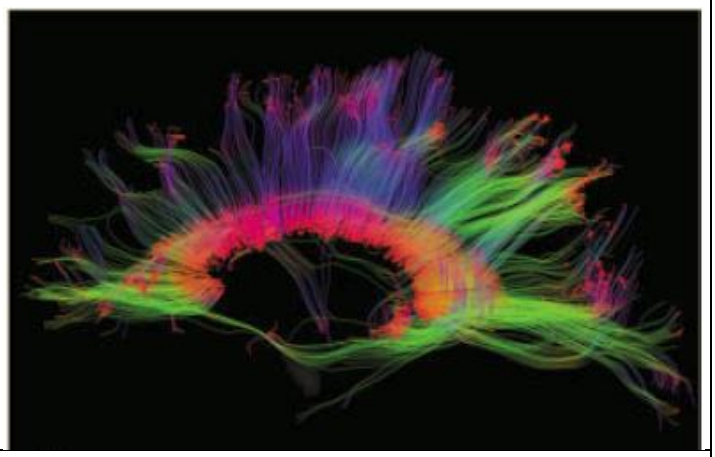

Figure 1: Rendering of white matter tracts in the brain, thanks to super-resolution MRI reconstruction.

Requirements of candidate	• Master degree in physics, engineering, math, or informatics. • Good command of English language (IELTS grade 6.5). • Ability to work in a multidisciplinary team. • Experience with programming.
Supervisor information	The project will be supervised by Prof. dr. Wiro J. Niessen, Dr. Stefan Klein, and Dr. Dirk H.J. Poot, in close collaboration with MRI physicists. For questions, please contact Stefan Klein at s.klein@erasmusmc.nl. *Website:* http://www.bigr.nl

Selected recent publications by the supervisory team:

- H. Smit, R. Pellicer Guridi, J. Guenoun, D.H.J. Poot, G.N. Doeswijk, M. Milanesi, M. Bernsen, G.P. Krestin, S. Klein and G. Kotek, T1 Mapping in the Rat Myocardium at 7 Tesla Using a Modified CINE Inversion Recovery Sequence, *Journal of Magnetic Resonance Imaging*, 39:901-910, 2014.
- W. Sun, W.J. Niessen, M. van Stralen and S. Klein, Simultaneous Multiresolution Strategies for Nonrigid Image Registration, *IEEE Transactions on Image Processing*, 22:4905-4917, 2013.
- D.H.J. Poot, G. Kotek, W.J. Niessen and S. Klein, Bias correction of maximum likelihood estimation in quantitative MRI, Proceedings of SPIE Medical Imaging 8669: Medical Imaging 2013: Image Processing, 2013.
- D.H.J. Poot, B Jeurissen, Y Bastiaensen, J. Veraart, W. Van Hecke, P.M. Parizel and J. Sijbers, Super-Resolution for Multislice Diffusion Tensor Imaging, *Magnetic Resonance Imaging*, 69:103–113, 2013.

- E. Plenge, D.H.J. Poot, M Bernsen, G. Kotek, G. Houston, P. A. Wielopolski, L. van der Weerd, W.J. Niessen and E. Meijering, Super-Resolution Methods in MRI: Can They Improve the Trade-Off Between Resolution, Signal-to-Noise Ratio, and Acquisition Time?, *Magnetic Resonance in Medicine*, 68:1983-1993, 2012.
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- M. de Groot, M.W. Vernooij, S. Klein, M.A. Ikram, F. Vos, S.M. Smith, W.J. Niessen and J. Andersson, Improving alignment in Tract-based spatial statistics: Evaluation and optimization of image registration, *NeuroImage*, 76:400-411, 2013.
- K. Hameeteman, S. Rozie, C.T. Metz, R. Manniesing, T. van Walsum, A. van der Lugt, W.J. Niessen and S. Klein, Automatic carotid artery distensibility measurements from CTA using nonrigid registration, *Medical Image Analysis*, 17(5):515-524, 2013.
- C.T. Metz, M. Schaap, S. Klein, N. Baka, L. Neefjes, C. Schultz, W.J. Niessen and T. van Walsum, Registration of 3D+t Coronary CTA and Monoplane 2D+t X-Ray Angiography, *IEEE Trans. Medical Imaging*, 32(5), 2013.
- K. Hameeteman, R. van 't Klooster, M. Selwaness, A. van der Lugt, J.C.M. Witteman, W.J. Niessen, and S. Klein, Carotid wall volume quantification from magnetic resonance images using deformable model fitting and learning-based correction of systematic errors, *Physics in Medicine and Biology*, 58(5):1605, 2013.
- M. de Groot, B.F.J. Verhaaren, R. de Boer, S. Klein, A. Hofman, A. van der Lugt, M.A. Ikram, W.J. Niessen and M.W. Vernooij, Changes in normal-appearing white matter precede development of white matter lesions, *Stroke*, 44:1037-42, 2013.
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- H.A. Kirisli, M. Schaap, S. Klein, S.L. Papadopoulou, M. Bonardi, C.H. Chen, A.C. Weustink, N.R.A. Mollet, E. P. A. Vonken, R.J. van der Geest, T. van Walsum and W.J. Niessen, Evaluation of a multi-atlas based method for segmentation of cardiac CTA data: a large-scale, multi-center and multi-vendor study, *Medical Physics*, 37(12):6279-6292, 2010.
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