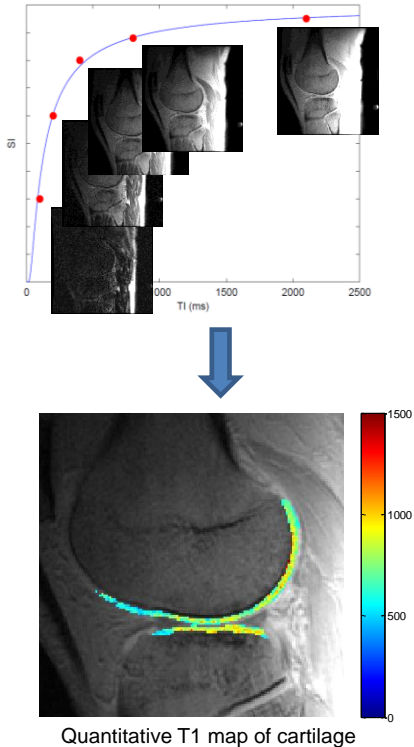


Erasmus MC / EUR CSC PhD 2014 Project Description

School / Department	The PhD candidate will be embedded in the Biomedical Imaging Group Rotterdam (BGR), which is a technical institute within the Erasmus MC, university medical center, Rotterdam, the Netherlands.
Project Title	Image processing for quantitative analysis of cartilage MRI in osteoarthritis patients
Abstract  <p>Quantitative T1 map of cartilage</p>	<p>Osteoarthritis (OA) is the most common joint disease in middle-aged and elderly, affecting over half of the population at some point in life. It is characterised by the degradation and loss of cartilage, for example in the knee. Treatment options and understanding of OA remain limited, due to lack of non-invasive imaging techniques to quantify disease progression and therapy response. Magnetic resonance imaging (MRI) is a promising modality for addressing this. However, the most widely used MRI techniques rely on qualitative, morphological cartilage assessment and are incapable of detecting early OA and subtle OA progression. Because of these limitations of standard MRI methods, there is an increasing interest in <i>quantitative</i> MRI techniques that enable measurement of biochemical cartilage composition rather than its morphology. Automated image processing plays a crucial role in the analysis and interpretation of these images.</p> <p>The aim of this project is three-fold: 1) Develop novel image processing methods for quantitative analysis; 2) Rigorously evaluate the methods in large-scale patient studies; 3) Integrate the methods in our software platform called "SPARCK" for routine usage by clinical researchers.</p>
Requirements of candidate	<ul style="list-style-type: none"> • Master degree in physics, engineering, or informatics. • Good command of English language (IELTS grade 7.0). • Ability to work in a multidisciplinary team. • Experience with programming.
Supervisor information	<p>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, expert radiologists, and the Orthopedics department. For questions, please contact Stefan Klein at s.klein@erasmusmc.nl.</p> <p>Website: http://www.bigr.nl</p>
Selected recent publications by the supervisory team: <ul style="list-style-type: none"> • H. Smit, R. Pellicer Guridi, J. Guenoun, D.H.J. Poot, G.N. Doeswijk, M. Milanese, 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, <i>Journal of Magnetic Resonance Imaging</i>, 39:901-910, 2014. • E.E. Bron, J. van Tiel, H. Smit, D.H.J. Poot, W.J. Niessen, G.P. Krestin, H. Weinans, E.H.G. Oei, G. Kotek, and S. Klein, Image registration improves human knee cartilage T1 mapping with delayed gadolinium-enhanced MRI of cartilage (dGEMRIC), <i>European Radiology</i>, 23(1):246-252, 2013. • J. van Tiel, E.E. Bron, C.J. Tiderius, P.K. Bos, M. Reijman, S. Klein, J. Verhaar, G.P. Krestin, H. Weinans, G. Kotek and E. Oei, Reproducibility of 3D delayed Gadolinium Enhanced MRI of Cartilage (dGEMRIC) of the knee at 3.0 Tesla in patients with early-stage osteoarthritis, <i>European Radiology</i>, 23:496-504, 2013. 	

- 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.
- 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.
- C.T. Metz, N. Baka, H.A. Kirisli, M. Schaap, S. Klein, L. Neefjes, N.R.A. Mollet, B.P.F. Lelieveldt, M. de Bruijne, W.J. Niessen and T. van Walsum, Regression-based cardiac motion prediction from single-phase CTA, *IEEE Transactions on Medical Imaging*, 31(6):1311-1325, 2012.
- F. van der Lijn, B.F.J. Verhaaren, M.A. Ikram, S. Klein, M. de Bruijne, H.A. Vrooman, M.W. Vernooij, A. Hammers, D. Rueckert, A. van der Lugt, M.M.B. Breteler and W.J. Niessen, Automated Measurement of Local White Matter Lesion Volume, *NeuroImage*, 59(4):3901-3908, 2012.
- Smal, N. Carranza, S. Klein, P.A. Wielopolski, A. Moelker, T. Springeling, M. Bernsen, W.J. Niessen and E. Meijering, Reversible Jump MCMC Methods for Fully Automatic Motion Analysis in Tagged MRI, *Medical Image Analysis*, 16(1):301-324, 2012.
- D.D.B. Carvalho, S. Klein, Z. Akkus, G.L. ten Kate, A.F.L. Schinkel, J.G. Bosch, A. van der Lugt and W.J. Niessen, Estimating 3D lumen centerlines of carotid arteries in free-hand acquisition ultrasound, *International Journal of Computer Assisted Radiology and Surgery*, 7(2):207-215, 2012.
- A.A. Isola, C.T. Metz, M. Schaap, S. Klein, M. Grass and W.J. Niessen, Cardiac motion-corrected iterative cone-beam CT reconstruction using a semi-automatic minimum cost path-based coronary centerline extraction, *Computerized Medical Imaging and Graphics*, 36(3):215-226, 2012.
- K. Murphy, et al. (54 authors), Evaluation of registration methods on thoracic CT: The EMPIRE10 challenge, *IEEE Transactions on Medical Imaging*, 30(11):1901-1920, 2011.
- C.T. Metz, S. Klein, M. Schaap, T. van Walsum and W.J. Niessen, Nonrigid registration of dynamic medical imaging data using nD+t B-splines and a groupwise optimization approach, *Medical Image Analysis*, 15 (2):238-249, 2011.
- S. Boehringer, F. van der Lijn, F. Liu, S. Günther, S. Sinigerova, S. Nowak, K.U. Ludwig, R. Herberz, S. Klein, A. Hofman, A.G. Uitterlinden, M.M.B. Breteler, A. van der Lugt, R.P. Wurtz, M.M. Nöthen, B. Horsthemke, D. Wiczorek, E. Mangold and M. Kayser, Genetic determination of human facial morphology: links between cleft-lips and normal variation, *European Journal of Human Genetics*, 19(11):1192-1197, 2011.
- 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.
- S. Klein, M. Staring, K. Murphy, M.A. Viergever and J.P.W. Pluim, elastix: a toolbox for intensity-based medical image registration, *IEEE Transactions on Medical Imaging*, 29(1):196-205, 2010.
- S. Klein, J.P.W. Pluim, M. Staring and M.A. Viergever, Adaptive stochastic gradient descent optimisation for image registration, *International Journal of Computer Vision*, 81(3):227-239, 2009.
- S. Klein, U.A. van der Heide, I.M. Lips, M. van Vulpen, M. Staring and J.P.W. Pluim, Automatic segmentation of the prostate in 3D MR images by atlas matching using localized mutual information, *Medical Physics*, 35(4):1407-1417, 2008.
- S. Klein, M. Staring and J.P.W. Pluim, Evaluation of optimization methods for nonrigid medical image registration using mutual information and B-splines, *IEEE Transactions on Image Processing*, 16(12):2879-2890, 2007.