Joint **MSk MEC** Seminar Series

Guest Speaker

Professor Daniel Rueckert

Imperial College London

Title: **Deep learning for extracting clinically useful information from medical images**

17th August 2018, Imperial College London
RSM **2.28** & **3.03**, Light Refreshment:**13.30** & Keynote: **14.00**

Abstract: This talk will introduce framework for reconstructing MR images from under sampled data using a deep cascade of convolutional neural networks to accelerate the data acquisition process. We show that such a method can outperforms state-of-the-art compressed sensing approaches, such as dictionary learning-based MRI (DLMRI) reconstruction, both in terms of image quality and reconstruction speed. We will also discuss image super -resolution approaches that are based on residual CNNs and which can reconstruct high resolution 3D volumes from 2D image stacks for more accurate image analysis and visualisation. In addition, we will present neural networks for medical image segmentation. More specifically, we will discuss unsupervised domain adaptation using adversarial neural networks to train a segmentation method which is more invariant to differences in the input data (across different scanners and acquisition protocols), and which does not require any annotations on the test domain. Finally, the talk will ensemble methods for segmentation, (Ensembles of Multiple Models and Architectures – EMMA) which provide robust performance through aggregation of predictions from a wide range of methods. EMMA can be seen as an unbiased, generic deep learning model which is shown to yield excellent performance, winning the first position in the BRATS 2017 competition among 50+ participating teams.

pm	**Other Short talks**
14.45	Julian Jones' Group: "BOUNCY BIOGLASS: How to regenerate articular cartilage with Bioglass" - Francesca Tallia
15.05	Angela Kedgley's Group: "Morphological variation of the first carpometacarpal joint quantified using statistical shape modelling" - Wan Rusli
15.25	Niamh Nowlan's Group: "Fetal movement and skeletogenesis: a mouse model" - Kaushik Mukherjee
15.45	Andrew Phillips' & Alison McGregor's Group: "Investigating bone health in transfemoral amputees" - Josh Kaufmann
16.05	Networking and drinks reception

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For all enquires or to arrange a meeting with the speakers, please contact:

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Abstracts for Other Short Talks

17th August 2018, RSM 2.28 & 3.03

Light Refreshment:**13.30** Talk: **14.00**

BOUNCY BIOGLASS: How to regenerate articular cartilage with Bioglass - Francesca Tallia

Abstract: Cartilage has limited self-repair ability. The current gold standard for treatment of cartilage defects is microfracture surgery, but it leads to the formation of inferior scar-like fibrocartilage. We propose that the repair can be supported by a scaffold, which is a 3D temporary template that substitutes the damaged tissue and guides the regeneration of healthy articular cartilage while biodegrading, capped with a curved dense layer of the same material that will provide an articular surface. This device is made of a patented sol-gel hybrid material, i.e. "Bouncy Bioglass", which showed unprecedented high flexibility with ability to recover the deformation under cyclic loading, while maintaining the bioactive behaviour typical of Bioglass.

Morphological variation of the first carpometacarpal joint quantified using statistical shape modelling - Wan Rusli

Abstract: Statistical shape modelling (SSM) can be used to perform shape analysis of anatomical structures. The first carpometacarpal (CMC) joint, which is located at the base of the thumb, is the second most common site for hand osteoarthritis. Being a saddle shaped joint, the shape of the first CMC joint affects its function. The aim of this study was to develop an SSM pipeline to analyse the shape variation of the first CMC joint in a population. The SSM pipeline comprises of four processes, namely rigid registration, relevance-based sampling, course-fine non-rigid registration, and projection pursuit principal component analysis. Our results show that there were shape variations at the volar beak angle and torsion of the first metacarpal. Future work will investigate possible links between this variation and the development of hand osteoarthritis

Fetal movement and skeletogenesis: a mouse model - Kaushik Mukherjee

Abstract: Prenatal musculoskeletal development is known to be influenced by fetal movements. However, in utero musculoskeletal activities and their influences on mechanical stimuli in the limbs are still poorly understood. This talk will introduce a numerical framework, combining musculoskeletal modelling with Finite Element (FE) analysis, to investigate mechanical stimuli in murine embryonic hindlimb during prenatal growth. Specifically, we will discuss how do we estimate the fetal movements based on the musculoskeletal modelling and how does that influence the mechanical stimuli in and around the joints of the hindlimb. We will also show how do these mechanical stimuli change over the prenatal growth and how do these evolutionary changes influence the growth and morphogenesis of bone and joint in mouse embryonic hind limb.

Investigating bone health in trans-femoral amputees - Josh Kaufmann

Abstract: Osteoporosis of the pelvis and femur occur in a large proportion of trans-femoral (TF) amputees. For amputees having osteoporotic bone has a disproportionate effect on functionality as it can compromise future prosthetic use. To prevent or reverse the onset of this skeletal disease we must first understand the potential underpinning mechanisms. Through the development of biofidelic musculoskeletal (MSK) and finite element (FE) computational models, we aim to determine the role that the socket and prosthesis play in deteriorating bone health in TF amputees. The MSK and FE models are patient specific and anatomically accurate, with the model geometry derived from MRI-scans. Early results confirm the hypothesis that weight-bearing through the ischial seat of a prosthetic socket causes changes to the load-path through bone and tissue when compared to weight-bearing on a healthy limb. In future, the FE model will be used in adaptive bone remodelling simulations (Phillips et al. 2015) to identify definitive differences in bone architecture within an amputated and healthy limb under equivalent loading cycles. Adaptive remodelling provides an opportunity for longitudinal studies comparing patient DEXA results to computational results of converged patient-specific FE models.

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