Two PhD candidates in computational biomechanics

We are looking for two PhD students to Biomechanics at Lund University that would like to apply to the new graduate school for Biomedical Engineering and Medical Physics, funded partly by the European Union and Marie Skłodowska-Curie actions.

The main topics of the projects are briefly described below. Any eligible candidates (please see call for the graduate school) are encouraged to contact Dr Isaksson below, with a brief CV and potential recommendations, for more information.

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**PhD student 1: Computational modelling and image processing of bone strength and hip fracture risk assessment**

*Project:*
Osteoporosis is defined as low bone mass, and results in a markedly increased risk of skeletal fractures. Development of new drugs to reduce bone loss or increase bone mass is promising. However, it requires that the individuals at risk can be accurately identified. Current osteoporosis diagnostics is largely based on measurements of bone mineral density (BMD), using 2D image obtained with dual energy X-ray absorptiometry (DXA). Novel methods that account for all characteristics of the bone and their influence on the bone’s resistance to fracture are needed.

The overall objectives are to integrate functional imaging of bone (clinical imaging together with mechanical modelling of bone strength) to improve prediction of fracture risk. This will be accomplished by combining DXA images with a pre-developed shape model, and finite element analysis (FEA).

First, clinical images with different resolution and level of details (ranging from DXA to high resolution cone beam CT) will be used to develop computational models using FEA. It will allow determination of the required features (e.g. anisotropy, cortical thickness, etc) to for accurate prediction of bone strength. Validation will be achieved by comparison with existing experimental mechanical testing data. Secondly, the findings will be implemented in a statistical shape and appearance model to determine if the modelling can lead to a more accurate prediction of fracture risk.

The project includes primarily numerical studies, but also involves some experimental work. It is a collaborative project with a 3 months secondment period at University of Eastern Finland, Kuopio, Finland.

**PhD student 2: Computational modelling of Achilles tendon biomechanics and mechanobiology**

*Project:*
Tendons connect muscles to bones and enable energy-efficient locomotion. The Achilles tendon is the largest and the most commonly injured tendon in the human body. Ruptures often occur during recreational sport activities, but can also be a result of ageing. Mechanical loading is a prerequisite for tendon healing. Controversial and often unsuccessful treatments of tendon
ruptures could be improved by elucidating how loading affects the biomechanics of intact tendons and the mechanobiological aspects of tendon healing.

The aim is to investigate how mechanical loading influences homeostatic and healing tendon function, structure and composition. The project includes refining and further validating an existing constitutive model for intact rat Achilles tendons. This will be conducted based on newly collected experimental data and focus on the fibre recruitment process and damage mechanisms in tendons. Next in the order is to develop and validate an adaptive mechanoregulatory model for tendon repair. The development of a computational mechanobiological scheme to predict the influence of mechanical loading on tendon tissue regeneration will be key to the project, in order to help elucidate the mechanobiological mechanisms at play.

The project involves primarily numerical studies and is a collaborative project with a 3 month secondment period at University of Eastern Finland, Kuopio, Finland.

Requirements for both PhD students

The successful candidates should be eligible to be admitted to the graduate school and also has the following:

Essential qualifications

- MSc degree (or close to graduating) in biomedical engineering, medical physics, mechanical engineering, or other relevant field.
- The mobility rules of the EU funded graduate school require that a PhD student cannot have resided for more than 12 months over the past 3 years in the country which he/she applies to.

Advantageous qualifications

- Knowledge and experience in biomechanics, finite element analysis, matlab and image processing.
- Documented ability to express yourselves in English in speech and writing, to work independently, and to work effectively in a multidisciplinary team, e.g. during the M.Sc. thesis.

Primary supervisor

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