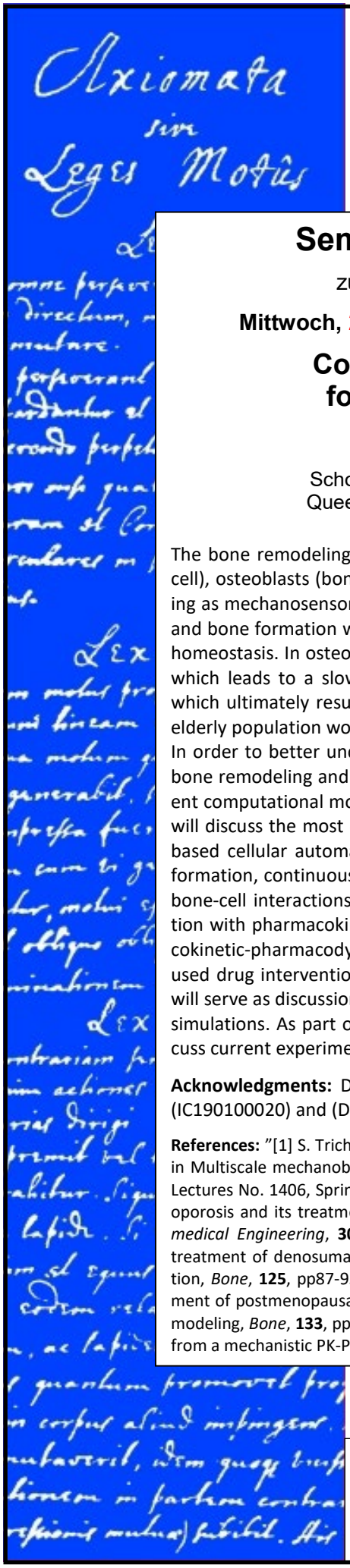

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Mittwoch, 22.03.2023, 10:00 Uhr, Egerlandstr. 5, Raum 0.044

Computational simulation techniques for understanding bone remodeling

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The bone remodeling process consists of the concerted action of osteoclasts (bone resorbing cell), osteoblasts (bone forming cells) and osteocytes (cells embedded in the bone matrix) acting as mechanosensory cells. In healthy conditions there is a balance between bone resorption and bone formation which warrants removal of microcracks due to fatigue loading and mineral homeostasis. In osteoporosis (OP) this balance is perturbed towards increased bone resorption which leads to a slow reduction of bone matrix and changes in the bone matrix properties which ultimately results in whole (organ) bone fractures [1]. OP affects a large portion of the elderly population worldwide.

In order to better understand the coupling of osteoclastic and osteoblastic cell populations in bone remodeling and the multitude of mechanobiological regulatory factors a variety of different computational models of bone-cell interactions have been developed. In this presentation I will discuss the most commonly applied mathematical models ranging from discrete single cell based cellular automata (CA) and stochastic models of spatio-temporal bone resorption and formation, continuous spatio-temporal models of bone remodeling to temporal-only models of bone-cell interactions. In particular, the latter models have been commonly used in combination with pharmacokinetic models of drug treatments. I will elaborate on these latest pharmacokinetic-pharmacodynamic (PK/PD) models of osteoporosis treatments. Examples of currently used drug interventions including denosumab [2,3] romozosumab [4], and PTH [5] treatments will serve as discussion points on which mechanisms are essential for accurate bone remodeling simulations. As part of the review of computational models of bone remodeling I will also discuss current experimental models/data that can serve for model calibration and validation.

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Biosketch Professor Peter Pivonka

Chair Biomedical Engineering
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Co-director Queensland Unit for Advanced Shoulder Research

Peter finished his PhD *with distinction* at the Institute for Mechanics of Materials and Structures at Vienna University of Technology (TU-Vienna) in 2001. In 2007 he completed his Doctor of Science thesis at TU-Vienna leading to the award of the Venia Docendi in *Continuum Mechanics and Biomechanics*.
Beginning of 2017 Peter was appointed the Professor and Chair of Biomedical Engineering in the School of Mechanical, Medical and Process Engineering at Queensland University of Technology. Peter leads biomechanics research across the Faculty of Science and Engineering with a focus on musculoskeletal (MSK) and mechanobiology research in a multidisciplinary environment bringing together engineers, clinicians, surgeons and basic scientist. Utilizing a synergist approach closely linking experimental and computational methods allows for innovative solutions to challenging MSK problems. Peter is the Deputy Director of the Australian Research Council (ARC) International Trainings and Transformation Centre (ITTC) for Joint Biomechanics recently established at QUT. He also holds the position of Research Director of the Queensland Unit of Advanced Shoulder Research (QUASR). Dr Pivonka is the immediate past President of the Australian and New Zealand Society of Biomechanics (ANZSB). He has published 150 peer reviewed papers, edited 1 book and 8 book chapters.

High-quality publications in top journals including J Bone and Mineral Research, Bone, Scientific Reports, Biomechanics and Modeling in Mechanobiology, J Biomechanics. Peter is frequently invited to deliver plenary, keynote and other invited talks at prestigious international conferences. He is an expert in biomechanics and musculoskeletal research using a variety of different techniques to assess systems behavior including multiscale computational modeling, medical imaging (CT, MRI, microCT, qBEI) and mechanical testing. His work on mechanobiological regulation of bone tissue and multiscale modeling of materials is nationally and internationally recognized. Peter's research interests are in mechanobiology, biomaterials, tissue engineering, musculoskeletal diseases (OP, OA, sarcopenia) and clinical interventions, estimation of material properties, multiscale modeling, systems biology, and high-resolution X-ray imaging.

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