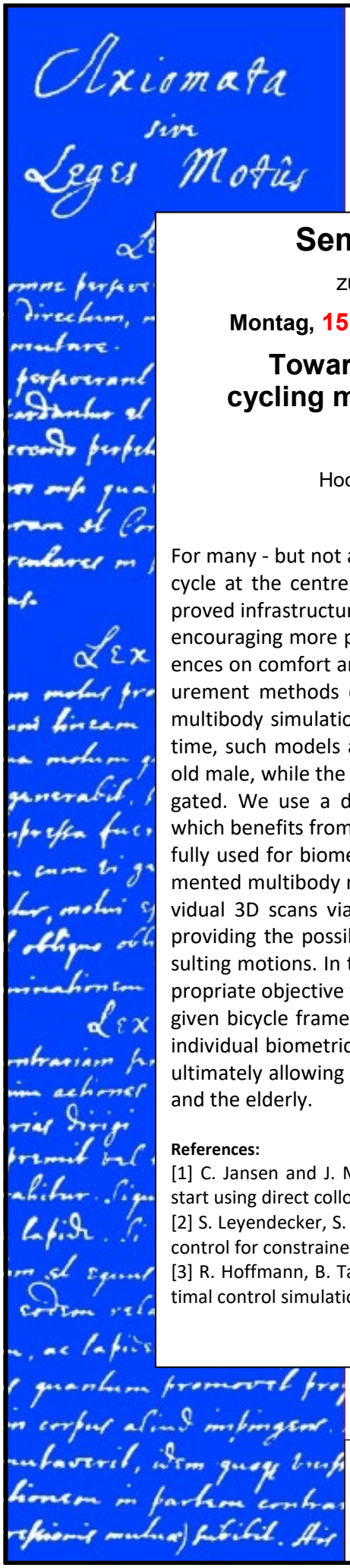


FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT

# Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

**Montag, 15.05.2023, 09:00 Uhr, Immerwahrstr. 1, Raum 01.025**

## Towards investigating gender differences in cycling motions using optimal control simulations

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For many - but not all - people, climate change and the energy crisis are putting the bicycle at the centre of their mobility considerations. In addition to the need for improved infrastructure, the stability and comfort of cycling also play an important role in encouraging more people to cycle. Simulations allow the influence of biometric differences on comfort and stability to be investigated more cost-effectively than the measurement methods currently used for bicycle fitting. Although bicycle dynamics and multibody simulation of cycling motions have been the subject of research for a long time, such models are usually based on the biometric data of an average 18-25 year old male, while the influence of gender differences on cycling motions is rarely investigated. We use a discrete mechanics and optimal control framework (DMOCC [2]), which benefits from its structure preserving formulation and has already been successfully used for biomechanical applications [3], to gain insight into this area. The implemented multibody model of a leg performing a cycling motion can be adapted to individual 3D scans via geometry parameters and bounds on joint angles and torques, providing the possibility to investigate the influence of biometric diversity on the resulting motions. In this first approach, we discuss several possibilities to formulate appropriate objective functions for cycling. The final goal of this study is to complement a given bicycle frame with software-selected adaptations so that it optimally adapts to individual biometric conditions, thus increasing comfort, safety and performance, and ultimately allowing greater participation in the mobility transition for women, children and the elderly.

**References:**

[1] C. Jansen and J. McPhee. Predictive dynamic simulation of Olympic track cycling standing start using direct collocation optimal control. Multibody Syst Dyn, Vol. 49, pp. 53–70, 2020
[2] S. Leyendecker, S. Ober-Blöbaum, J. Marsden, and M. Ortiz. Discrete mechanics and optimal control for constrained systems. Opt Contr Appl Met, Vol. 31, pp. 505-528, 2010.
[3] R. Hoffmann, B. Taetz, M. Miezal, G. Bleser and S. Leyendecker. On optical data-guided optimal control simulations of human motion. Multibody Syst Dyn, pp. 1-22, 2019.

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