Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Donnerstag, 04.12.2014, 15:00 Uhr, Haberstraße 1, Raum 01.025

Optimization in Robotics and Biomechanics with Focus on Human and Humanoid Locomotion

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In the field of robotics and biomechanics there is a great variety of problems that can be solved by a great variety of different optimization approaches, reaching from the analysis of human motion by inverse optimal control algorithms on the one side to the development of efficient control algorithms for robot control (e.g. non-linear model predictive control) on the other side.

In the first part of this talk we give an overview about the wide span of projects our research group is involved in and point out the role of optimization in each of these projects which are related to e.g. medicine, archeology, arts, neuroscience, and robotics.

In the second part of the talk we set the focus on the analysis of human gait by using inverse optimal control. To this end we formulate a bi-level optimization problem, with an optimal control problem modelling human gait on the lower level and a least square fit to real motion capture data on the upper level. The result of this bi-level problem is a weighted combination of optimization criteria that produces a gait which is close to the measured one. To solve the inverse optimal control problem, we rely on a direct all-at-once approach, presented by Hatz et al., 2012. The main idea is to discretize the lower level optimal control problem by means of a multiple shooting approach and to replace the discretized problem by its KKT-conditions. In general, this results in a mathematical program with equilibrium constraints (MPEC), which is then solved by a specifically tailored sequential quadratic programming (SQP) method which fully exploits the inherent structure.

Modeling issues and algorithmic details will be discussed. First results of inverse optimal control in simulation and forward optimal control on a real robot will be shown.

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