TECHNISCHE UNIVERSITÄT MÜNCHEN
LEHRSTUHL FÜR INFORMATIONSTECHNISCHE REGELUNG
ORDINARIA: UNIV.-PROF. DR.-ING. SANDRA HIRCHE

F O R S C H U N G S P R A X I S

Inverse Dynamics for Robotics in Maximal Coordinates

Problem description:

Most dynamic simulation tools parameterize the configuration of multi-body robotic systems using minimal coordinates (also called generalized or joint coordinates). However, maximal-coordinate approaches have several advantages over minimal-coordinate parameterizations. So far, algorithms calculating the forward dynamics—i.e. the trajectory given forces—of systems in maximal coordinates have been developed [1, 2]. Algorithms for inverse dynamics—i.e. calculating forces given a trajectory—have only been provided for minimal coordinates [3] and a formulation in maximal coordinates has not been attempted.
Inverse dynamics algorithms can be used for a variety of control purposes such as computed-torque control or disturbance observers. The special structure of formulations in maximal coordinates could provide some interesting challenges and advantageous properties for such applications.
The aim of this thesis is therefore to evaluate how existing minimal-coordinate algorithms can be used in maximal-coordinate parameterizations and to develop an inverse-dynamics algorithm in maximal coordinates based on the findings. Subsequently, the results could be extended as a basis for a master thesis.

Work schedule:

- Literature research on inverse-dynamics algorithms
- Development of an inverse-dynamics algorithm in maximal coordinates
- Evaluation of performance of the implemented algorithm

Bibliography:

[1] D. Baraff. Linear-Time Dynamics Using Lagrange Multipliers. In *ACM SIGGRAPH 96*, pages 137–146, 1996.
[2] J. Brüdigam and Z. Manchester. Linear-Time Variational Integrators in Maximal Coordinates (accepted). In *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, 2020.
[3] B. Siciliano and O. Khatib. *Springer Handbook of Robotics*. Springer, 2016.

Supervisor:	M. Sc. Jan Brüdigam
Start:	As soon as possible
Delivery:	After 9 weeks (full time) or 20 weeks (part time)

(S. Hirche)
Univ.-Professor