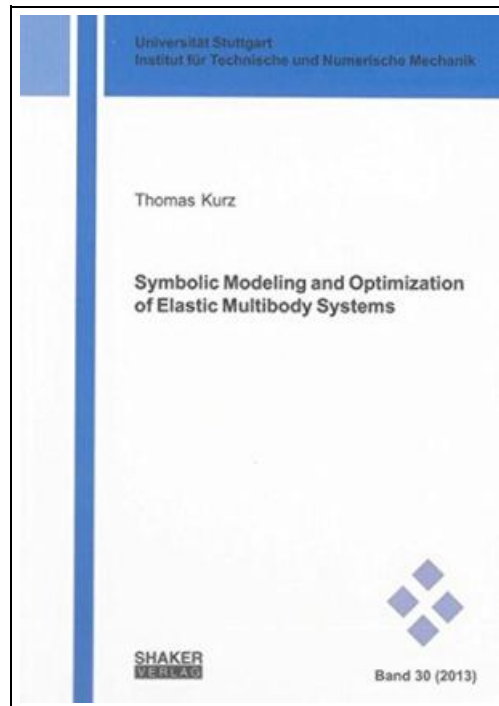# Symbolic Modeling and Optimization of Elastic Multibody Systems

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(Dr. Bryon Gleichner)

SYMBOLIC MODELING AND OPTIMIZATION OF ELASTIC MULTIBODY SYSTEMS

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Shaker Verlag Jul 2013, 2013. Buch. Condition: Neu. Neuware - The method of elastic multibody systems is a powerful tool to simulate and analyze mechanical systems. Its main applications are systems with large, nonlinear motions but small deformations. Here, the software Neweul-M2 is described, which is a simulation package in Matlab. The author of this thesis was involved in its development. It uses the Matlab Symbolic Math Toolbox to perform symbolic computations in order to set up the kinematics and equations of motion of the system under consideration. With this approach, the symbolic engine and the large numerical toolset of Matlab can be applied. The symbolic equations of motion enable an efficient optimization of the system. In the first part, the fundamental relations to describe multibody systems and to set up the equations are explained. Here, four formulations are presented as they are implemented in Neweul-M2. Two of which result in symbolic equations, while the other two result in numerical algorithms. The different formulations are investigated by their performance on three systems. All these algorithms use only very few algebraic constraint equations. Usually, their information is contained inherently in the equations of motion. However, for some systems, e.g. when using kinematic loops, algebraic constraints are preferred. The easiest way to handle such systems is to choose an appropriate integrator which ensures that the constraint equations are respected. In these formulations, most often only the time derivatives of the constraints are considered, which can lead to integration errors. Alternatives are methods, where the generalized coordinates are projected onto the available directions of motion. Then, this combination locally respects the constraint equations, making a root-search unnecessary. Commonly, the user has to select the set of independent coordinates, when this method is applied. While this may work well for some systems, this often...

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