Simulating Collisions within the Modelica MultiBody Library

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Abstract

In this paper an approach for handling collision within the Modelica MultiBody library is presented. Therefore, a short overview about collision consideration for multibody simulation is given. Different methods for calculating the contact reactions are discussed and their potentials for implementation in a free Modelica library are deliberated. Furthermore the implementation of this collision library, using a penalty-based collision approach and the *Bullet Physics Library* for collision detection is described. The application is demonstrated in examples and limitations are brought up. Although some drawbacks restrict usability, the library can be used to increase the level of detail for multibody simulation models.

Introduction

Many physical systems cannot be simulated in a feasible manner without the description of collision interaction. Not only the typical applications, like wheel-road- contact, newton's cradle or a bouncing ball need collision consideration, but especially real-life models require contact handling. For example, simulation of typical working processes for construction machines, with lifting rocks can benefit from this. But also machine elements like mechanical springs require collision handling for simulations including dynamic loads. For the Modelica Library Modelica. Mechanics.MultiBody (M.MB) several collision handling considerations have been made, with two to be shortly mentioned. In [1] Otter et al. introduced an extension to the M.MB library with capabilities of handling collisions. Collision detection using different approaches of surface representation were shown. Engelson [2] described a way of contact implementation using impulse-based and penalty-based methods. However, those approaches have never been available in public. To offer collision handling to general public, CollisionLib – the library presented here – will be freely available. Although the functionality of this very first version has only been tested in Dymola, support for OpenModelica and other Modelica environments are planned for the future.

References

[1] Otter, M. et al. Collision Handling for the Modelica MultiBody Library. In: Proceedings of the 4th Modelica Conference 2002, Hamburg, Germany, Modelica Association, 7-8 March 2005.

[2] Engelson, V. Integration of Collision Detection with Multibody System Library in Modelica. Linköping, Sweden: Thesis, Department of Computer and Information Science, Linköping University, 2000.