A Modelica Contact Library for Idealized Simulation of Independently Defined Contact Surfaces

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Considering technical use-cases one often finds multibody mechanics that typically comprise mainly fixed (e.g. kinematic chains) and few loose couplings, where dynamic contact phenomena take place. Nevertheless, modeling contacts is “a key factor and a challenging problem in simulation of multibody systems, where a balance between performance and accuracy has to be found” [1]. However, to the best of our knowledge, there is currently no Modelica library available to handle contact problems in any level of detail. The library presented in this paper implements contact modeling by means of non-central contact blocks. It also provides ready-to-use blocks for simple contact surfaces. The surface blocks can be connected to any kind of rigid body by a *frame* connector and the dimensions of the surface can be parameterized. We introduce a new interface to connect the surface definition with the contact blocks, which makes the surface dimensions available for the contact calculation. The overall aim is to enable the designer of mechatronic systems to perform simulations of systems including idealized representation of contacts. Therefore, we use an idealization of the so called “foundation model” [2] that is based on single force elements. Assuming that the contact area is not only relatively small but also of an idealized shape, we describe it by means of single contact points. A nonlinear spring-damper element is inserted to calculate the normal force between these points of the colliding surfaces. The normal force is then used to determine the friction force between the two bodies by a continuous approximation of the Stribeck curve. This requires the previous identification of potential contact points on the rigid body surfaces and the continuous determination of the normal direction. For these purposes, we provide analytic solutions for simple geometries in our library. As a starting point, we focused on *spherical*, *cylindrical* and *plane* surfaces, either in *rectangular* or *circular* shape. Depending on the shape of the contact area, we use 1 (punctiform), 2 (linear) or 4-5 (planar) points to describe it. Exemplarily, the results of three experiments are shown and compared to benchmark simulations in RecurDyn. They demonstrate that the idealized contact library provides a powerful and easy to use opportunity to model contact phenomena of simple contact geometries. After making our library publicly available, we hope to identify further opportunities for improvement with the help of the Modelica community in the future.

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References

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