Contact Types Hierarchy and Its Object-Oriented Implementation

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ABSTRACT

Technology of the object-oriented implementation for the multibody dynamics models is the key feature when developing the corresponding computer structures. We are based on an approach originating from concepts described in [1]. Following the guidelines outlined there one can develop the family of the constraint abstractions, really classes, adapted to any type of the machinery applications and relatively easily implement corresponding family of Modelica models. One also can reorder these classes hierarchically using sequences of the behaviour inheritance. In case of the ideal constraints models of contact usually are represented by the point-contact models. These are reduced to two models of constraint: (a) ideal rolling; (b) ideal sliding, both with rigid surface of contact.

More rich possibilities open if we adopt compliance for contacting bodies. According to experience of development for models of elastic contacting of rigid bodies interactions in the multibody dynamics [2] flexibility, namely a feature of class parametrization, provided by the modeling language may be used to utilize a wide variety of different properties concerning contact of solids. The properties are mainly of the following categories: (a) geometric properties for surfaces in vicinity of the contact patch (gradients of the functions defining surfaces, their Hesse matrices); (b) a model for computing the contact area dimensions and normal elastic force; (c) model for the normal viscous force of resistance; (d) model for the tangent forces.

A submodel of the geometry properties is to describe analytically algebraic surfaces of the structure complex enough. To implement the normal force computation one can choose from several possibilities including for instance the Hertz model and/or its volumetric modification. Force of viscous resistance also can be modeled in several different ways: linear, non-linear, etc. In the models of tangent forces one can adopt either “simplest” approaches based on the Amontons–Coulomb friction or more complex ones represented by the Contensou–Erismann, and other models. One should add here also models for the contact forces torques resisting turning and/or rolling relative motion for bodies at contact.

Finally a model of the omni-vehicle dynamics has been analyzed as an example.

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