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OBJECT-ORIENTED IMPLEMENTATION OF A UNILATERAL POINT–CONTACT CONSTRAINT MODEL WITH FRICTION IN FRAME OF THE OMNI VEHICLE MULTIBODY SYSTEM

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An omni vehicle dynamics attracts currently serious attention as a topic in frame of the multibody dynamics [1, 2]. The omni vehicle is one having omni wheels which in turn equipped by rollers along the wheel rim. One knows simplified, idealized models having contacting rollers as an infinitely small discrete elements. Thus one has a resulting non-holonomic constraint being "uniformly distributed" over the wheel rim.

We are going to develop a technique for building up a dynamical virtual prototype of the physical model for the omni vehicle including dynamical models of physical rollers. Doing so we are based on methods of virtual prototyping utilized previously in several examples of the multibody systems dynamics [3].

We assume that rollers are located on the omni wheel such that for the wheel vertically aligned a projection of the curve of contact consists of segments sequence each corresponding to the contact of individual roller. These segments are connected in a way such that for the point of rollers switch a normal relative velocity at contact is equal to zero. This means the normal impact is always absent. Discontinuities of the tangent relative sliding velocity are absent for zero angle of the roller axis inclination to the wheel plane. But in the worst case, if angle of inclination is non-zero, the tangent force of friction may have discontinuity of the first kind. Thus the wheel, and rollers, linear and angular velocities will be continuous at an instant of roller switching at contact.

Algorithm for contact tracking plays an important role for correct and efficient work of computer model for contacting process of the roller and horizontal surface. It is possible to arrange the contact tracking procedure simple enough in case of the omni wheel vertically

aligned. According to Signorini's law a following alternative is implemented for each individual roller: (a) contact takes place – relative normal velocity at contact should be zero; (b) contact is absent – normal reaction (and tangent too) of unilateral constraint should be zero. Generally implementation of the unilateral constraint model is based on the results outlined in [4].

An assembling process of the omni vehicle prototype is implemented by two steps: (a) assembling of the omni wheel consisting of the wheel itself and set of rollers attached to the wheel; (b) assembling of the vehicle by instantiating objects of the omni wheel class from stage (a) into the container class of the vehicle prototype.

To connect rollers, rather objects of the roller class, and the wheel we use model of the joint constraint previously developed and described in [3]. Codes of all the classes / models for the prototype are implemented on the Modelica language. The model of the whole vehicle is "assembled" on the second stage of the assembling process. Interconnections here were also implemented as objects of the same joint class from stage (a). These joints connect the vehicle body and each of wheels. All joints above allow relative rotation without any resistance and lock sliding along the joint axis.

Computer experiments were performed for the case under consideration. Corresponding results were interpreted. For instance, an evolution of the contact process for one wheel of the three wheeled vehicle was analysed.

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