

# Dynamical Model of a Vehicle with Omni Wheels: Improved and Generalized Contact Tracking Algorithm

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A model of the multibody dynamics for an omni wheel assuming embedded in a frame of wider dynamical environment of the whole vehicle. Modelica primitives developed earlier (Kosenko, 2005; Kosenko et al, 2006) for the multibody applications with contacts involving friction are used. Generalization of (Kosenko and Gerasimov, 2014) has been performed for the model of contact tracking algorithm between roller and horizontal floor. Generalization includes non-zero angle between the roller axis of rotation and plane of the omni wheel. Contact tracking algorithm is implemented in two cases: (a) implicit and (b) explicit.

A comparison has been performed for these cases in frame of the omni wheel dynamics. A verification of the whole omni vehicle dynamics has been performed earlier (Kosenko and Gerasimov, 2014) but for the simpler case: for zero value of the angle of roller axis of rotation with respect to the omni wheel plane. Models for these cases (a) and (b) are currently “embedded” into the omni vehicle model earlier verified. Such a construct has been implemented by means of the object-oriented modeling. For simplicity we analyze currently a multibody system comprising the wheel plus set of rollers being mounted along the wheel circumference. A remainder of the vehicle is replaced by the wrench properly arranged in a way such that the wheel keeps its vertical orientation permanently. Really, the wrench mentioned is an implementation of a virtual dynamical testbench.

The performed computations have shown that two algorithms of the contact tracking generate completely identical dynamics of the whole multibody system. In addition, class hierarchy is considered for the behavioural inheritance in a model of the roller and the floor contacting involving the Coulomb friction.

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## References

- I. Kosenko and K. Gerasimov. Implementation of the omni vehicle dynamics on Modelica. In *Proceedings of the 10th International Modelica Conference*, pages 311-322, March 2014.
- I. I. Kosenko. Implementation of unilateral multibody dynamics on Modelica. In *Proceedings of the 4th International Modelica Conference*, pages 13-23, March 2005.
- I. I. Kosenko, M. S. Loginova, Ya. P. Obraztsov, and M. S. Stavrovskaya. Multibody systems dynamics: Modelica implementation and bond graph representation. In *Proceedings of the 5th International Modelica Conference*, pages 213-223, September 2006.