Modeling and Simulation of Contacts in SIMPACK

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Contact situations in SIMPACK simulations originate from all fields of application. Probably most prominent are rail-wheel contacts, contacts in meshing gear pairs, chain drives, cam-roller and piston-liner contacts in combustion engines. Whereas for example the cam-roller contact can be modelled by general SIMPACK elements for curve to curve contacts, the rail-wheel contact is, like tire models, an individual field of research with approaches specialized to its detailed geometry and materials even regarding the tangential creep force distribution and will not be addressed in this presentation in further detail.

SIMPACK models contacts between bodies as discrete point-to-point interactions. Depending upon the geometry of the contacting bodies and related assumptions made by the user setting up the model, a contact element can cover exactly one up to arbitrary high numbers of contact points defining the discretization of the contact regions.
The normal contact force formulations cover constant stiffness and damping, HERTZian contact up to general non-linear force formulation depending upon penetration depth and velocity. Depending on the contact dynamics, the user may choose to exactly resolve the times of closing contact during time integration which might help for higher robustness and accuracy. For the tangential forces of contact, regularized COULOMB as well as exact stick-slip can be evaluated. For the second, the discrete times of stick-slip transitions are resolved during time integration to update the system's algebraic equations. The formulation leads to continuous system velocities with non-continuous time derivatives.

The presentation will briefly display these approaches with the help of typical industrial applications in SIMPACK. Along with this, the discussion will also cover customer demands as well as applicability of set-valued formulations in the respective field of contact problems.