Time-stepping Methods for Stiff Multi-Rigid-Body Dynamics with Contact and Friction

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(co-author Florian Potra, University of Maryland, Baltimore County) The lack of classical solutions for the problem of determining the dynamics of a system of rigid bodies subject to non-interpenetration and Coulomb frictional constraints has prompted the investigation of time-stepping schemes having velocities and impulses as the fundamental variables. Such schemes always produce a solution to the discretized equations of motion (they are consistent), but most of them do not accomodate stiffness well since they reduce to the explicit Euler method in the unconstrained case.

In this work we develop a time-stepping scheme for stiff multi-rigid-body dynamics with contact and friction, based on the linearly implicit Euler method embedded in a linear complementarity problem. We show that the method remains consistent for the most commonly encountered types of stiff forces. We discuss the behavior of the method as the stiffness parameters are increased to infinity, and we present several examples to illustrate the stability issues.