1st Pan-American Congress on Computational Mechanics - PANACM 2015
XI Argentine Congress on Computational Mechanics - MECOM 2015
S. Idelsohn, V. Sonzogni, A. Coutinho, M. Cruchaga, A. Lew & M. Cerrolaza (Eds)

NUMERICAL TIME INTEGRATION SCHEMES FOR NONSMOOTH MULTIBODY SYSTEMS IN THE EVENT-DRIVEN FRAMEWORK

MOUNIA HADDOUNI[1,3], VINCENT ACARY[1,2,*], STEPHANE GARREAU[3], JEAN-DANIEL BELEY[3] AND BERNARD BROGLIATO[1]

[1]INRIA
655, Av. de l'Europe. 38334 Saint Ismier Cedex, France
firstname.lastname@inria.fr and http://bipop.inrialpes.fr

[2]INRIA Chile
Av. Apoquindo 2827, Las Condes, Santiago, Chile
firstname.lastname@inria.cl and http://www.inria.cl

[3]ANSYS France
11, Av. Albert Einstein, 69100 Villeurbanne, France
firstname.lastname@ansys.com

ABSTRACT

This work is devoted to the analysis of numerical integration methods for nonsmooth multibody dynamics with joints, unilateral contacts and impacts. With an event–driven strategy, the smooth dynamics, which is integrated between two events, may be equivalently formulated as a Differential Algebraic Equation (DAE) of index 1, 2 or 3. When a numerical time–integration scheme is used, these formulations are no longer equivalent in terms of accuracy and drift of constraints. Usually, the robustness of an event–driven scheme is very dependent on the kinematic level of the formulation of the constraints and the induced drift in the numerical simulation. In this article, several numerical time integration methods for each formulation are compared: the generalized-α scheme for index-3 DAEs and index-2 DAEs , HEM5 and PHEM56 for index-2 DAEs, and RK4 and Runge-Kutta-Fehlberg for index-1 DAEs. We compare these schemes in terms of efficiency, violation of the constraints and the way they handle stiff dynamics. Comparisons are performed on academic examples and numerous industrial benchmarks. One of the major conclusions is that the index-2 DAEs solvers prove to be better than other schemes to maintain low drifts. When the dynamics is stiff, implicit schemes outperform explicit and half-explicit methods which are sometimes unable to compute the dynamics when the system's frequency range is wide.