Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXXIII, págs. 11-11 (resumen)
Graciela Bertolino, Mariano Cantero, Mario Storti y Federico Teruel (Eds.)
San Carlos de Bariloche, 23-26 Setiembre 2014

# NONSMOOTH GENERALIZED-$\alpha$ SCHEME FOR THE SIMULATION OF MULTIBODY SYSTEMS

**Olivier Brüls[a], Vincent Acary[b] and Alberto Cardona[c]**

[a]*University of Liège, Department of Aerospace and Mechanical Engineering (LTAS), Chemin des Chevreuils, 1 (B52), 4000 Liège, Belgium, o.bruls@ulg.ac.be*

[b]*INRIA Rhône-Alpes, Centre de Recherche Grenoble, 655 avenue de l'Europe, Innovall'ee de Montbonnot, 38334 St Ismier Cedex, France, vincent.acary@inria.fr*

[c]*CIMEC, Universidad Nacional del Litoral / Conicet, Predio Conicet Santa Fe, Colectora Ruta Nac 168 / Paraje El Pozo, 3000 Santa Fe, Argentina, acardona@unl.edu.ar*

**Keywords:** Nonsmooth contact dynamics, Flexible multibody system, Time integration, Time-stepping schemes, Index reduction

**Abstract.** We present a formalism for the transient simulation of nonsmooth dynamic mechanical systems composed of rigid and flexible bodies, kinematic joints and frictionless contact conditions. The proposed algorithm guarantees the exact satisfaction of the bilateral and unilateral constraints both at position and velocity levels. Thus, it significantly differs from penalty techniques since no penetration is allowed. The numerical scheme is obtained in two main steps. Firstly, a splitting method is used to isolate the contributions of impacts, which shall be integrated with only first-order accuracy, from smooth contributions which can be integrated using a higher order scheme. Secondly, following the idea of Gear, Gupta and Leimkuhler, the equations of motion are reformulated so that the bilateral and unilateral constraints appear both at position and velocity levels. After time discretization, the equations of motion involve two complementarity conditions and it can be solved at each time step using a monolithic semi-smooth Newton method. The numerical behavior of the proposed method is studied and compared to other approaches for a number of numerical examples. It is shown that the formulation offers a unified and valid approach for the description of contact conditions between rigid bodies as well as between flexible bodies (1).

## REFERENCES

[1] O. Bruls, V. Acary, A. Cardona, Simultaneous enforcement of constraints at position and velocity levels in the nonsmooth generalized-$\alpha$ scheme. Computer Methods in Applied Mechanics and Engineering, http://dx.doi.org/10.1016/j.cma.2014.07.025. (2014).