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NONSMOOTH-α TIME INTEGRATION FOR FRICTIONAL CONTACT PROBLEMS

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This work adresses the development of numerical non-smooth techniques to deal with the dynamics of multibody systems with rigid, flexible, and frictional contacts elements. The response of flexible bodies with contacts and vibrations requires accurate methods to properly represent the motion. The nonsmooth generalized-α method presented was initially developed for frictionless contact problems[2]. This method splits the motion into smooth and nonsmooth behaviours, combining second order accurate integration of the smooth dynamics and first order for the nonsmooth contributions. This scheme also has the advantage that the unilateral constraints are imposed at position and velocity levels, preventing any non-physical penetration.

In this work, we introduce a modification of the splitting part to get a nonsmooth generalized-α scheme where the jacobian matrix is a lower triangular matrix. This means that the set of equations for the smooth motion does not depend on the velocity and position corrections. Furthermore, the position correction does not depend on the velocity correction. These two properties allow us to solve the system sequentially: (i) the smooth motion is solved, (ii) the position correction is determined and (iii) the velocity correction is calculated. This method improves the convergence with respect to the original scheme. Moreover, it is extended to include frictional contacts following the idea proposed by Alart and Curnier [1]. This leads to an implicit formulation of the contact problem which can be solved at every time step using a Newton semi-smooth algorithm. Finally, to demonstrate the capabilities of the method and the reduction in the number of needed iterations to converge, several simple examples are studied.

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