Sweeping process for impact problem with a general inertia operator

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Abstract

We consider a mechanical system with a finite number of degrees of freedom, submitted to a perfect unilateral constraint: it must stay in a closed set L, defined by a single inequality. We consider the case of partial elastic impacts without friction i.e the reflexion of velocities at impacts is described by a Newton's law with a restitution coefficient $e \in [0; 1]$. We use Moreau's formulation of the dynamics as a measure differential inclusion. As we now assume that the inertia operator is state-dependent (in a Lipschitz-continuous way), this work generalizes results obtained by J. J. Moreau , M. M. Marques where the inertia operator reduces to identity and R. Dzonou in the case of an inelastic contact with a general inertia operator. A numerical scheme is presented which enables us to approximate a solution of the Cauchy problem. As we are dealing with state-dependence we have to consider different kinetic energy norms in the estimates of the total variation of the numerical solution. By using the sweeping process technique, a 'variational formulation' and local kinetic metrics we are able to show the convergence of a subsequence of numerical solutions to a solution of the contact dynamic problem, which yields an existence result. Some numerical results for a double pendulum model are also presented.

Keywords
dynamics with impacts, differential inclusion, sweeping process, inertia operator, restitution coefficient.