DYNAMICS OF AN ELASTO-PLASTIC OSCILLATOR WITH UNILATERAL CONTACT CONSTRAINTS

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This paper presents the preliminary findings from the analysis of the dynamics of an elasto-plastic oscillator with unilateral contact constraints using a mixed Lagrangian approach. The problem is challenging because both plasticity and contact are non-smooth phenomena. It is shown that the mixed Lagrangian formulation provides a convenient framework to analyze such problems. As opposed to the Lagrangian in classical mechanics which is a function of displacements and velocities, the mixed Lagrangian used here is in addition also a function of forces and impulses. The evolution of the state variables of the oscillator in time is provided a weak formulation using Hamilton's principle. For numerical solution, a discrete variational integrator is derived starting from the weak formulation. The integration of each step is a constrained minimization problem. An incremental complementary potential energy which is a function of the contact force and the elasto-plastic restoring force is minimized subject to the yield constraints. The Augmented Lagrangian algorithm in conjunction with the Nedler and Mead downhill simplex method is used for the solution of this optimization problem. The problem is globally convergent over the space of forces in each step. Some numerical results are also presented.

References

Keywords: plasticity, unilateral contact, Hamilton's principle