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A weighted finite element mass redistribution method for dynamic contact problems

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Abstract

This paper deals with a one-dimensional wave equation being subjected to a unilateral boundary condition. An approximation of this problem combining the finite element and mass redistribution methods is proposed. The mass redistribution method is based on a redistribution of the body mass such that there is no inertia at the contact node and the mass of the contact node is redistributed on the other nodes. The convergence as well as an error estimate in time are proved. The analytical solution associated with a benchmark problem is introduced and it is compared to approximate solutions for different choices of mass redistribution. However some oscillations for the energy associated with approximate solutions obtained for the second order schemes can be observed after the impact. To overcome this difficulty, a new unconditionally stable and a very lightly dissipative scheme is proposed.

Keywords: Numerical solution, mass redistribution method, variational inequality, unilateral contact, energy conservation. 2008 MSC: 35L05, 35L85, 49A29, 65N10, 65N30, 74M15.

1. Introduction

The present paper highlights some new numerical results obtained for a one-dimensional elastodynamic contact problem. Dynamical contact prob-

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