Material Point Method for deteriorating inelastic structures.

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ABSTRACT

The material point method (MPM) is one of the latest developments in particle in cell methods (PIC). The structure is discretized into a number of material points that hold all the state variables of the system [1] such as stress, strain, velocity, displacement etc. These properties are then mapped to a temporary background grid and the governing equations are solved. The momentum conservation equations (together with energy and mass conservation considerations) are solved at the grid nodes. The state variables of the particles are then updated by transferring the solutions from the grid nodes back to the material points. Since the background grid is used only to solve the governing equations at the end of each computational step it can be reset to its undistorted form and thus mesh distortion and element entanglement are avoided.

In this work an explicit MPM accounting for elastoplastic material behaviour with degradations is proposed. The stress-strain constitutive law is determined according to the strain decomposition rule [2] where the strains are uncoupled into an elastic and an inelastic part. The inelastic constitutive material law provides a smooth transition from the elastic to the inelastic regime and accounts for the different phases during elastic loading, unloading, yielding and stiffness and strength degradation. Heaviside type functions are introduced [3] that act as switches, incorporate the yield criterion and the terms for stiffness and strength degradation as in the Bouc-Wen model of hysteresis [4]. The resulting constitutive law relates stresses and strains with the use of the tangent modulus of elasticity, which now includes the Heaviside functions and gathers all of the governing inelastic degrading behavior.

REFERENCES

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