

On variational updates for non-associative kinematic hardening of Armstrong-Frederick-type

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Abstract

In this paper, a variational constitutive update for finite strain plasticity theory under consideration of nonlinear kinematic hardening is presented. The proposed scheme permits to compute the unknown state variables such as the plastic part of the deformation gradient, together with the deformation mapping, by means of a fully variational principle. More precisely and in line with the postulate of minimum potential energy, the considered mechanical problem is solely driven by energy minimization. Obviously, the advantages resulting from such a variationally consistent method are manifold. While variational constitutive updates have been successfully derived for relatively simple fully isotropic plasticity models, their extensions to more realistic constitutive laws, particularly to those showing non-associative evolution equations, is highly challenging. In the present paper, a class of finite strain plasticity models characterized by nonlinear kinematic hardening resulting from non-associative evolution equations is recast into an equivalent minimization principle yielding a variational constitutive update. As an important prototype, a variationally consistent Armstrong-Frederick model is discussed.