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Large strain finite element analysis of a local second gradient model: application to localization. (English) Zbl 1098.74705

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Summary: A large strain finite element formulation based on a local second gradient plasticity model is presented. The corresponding constitutive equations were developed as a direct extension of microstructured [*K. B. Ranger*, SIAM J. Appl. Math. 24, 556–561 (1973; Zbl 0236.35024); *R. D. Mindlin*, Arch. Ration. Mech. Anal. 16, 51–78 (1964; Zbl 0119.40302)] or micromorphic [*A. C. Eringen*, Mechanics of Generalized Continua, IUTAM Symposium, Kröner (ed.), Springer: Berlin, 18–35 (1967); J. Math. Mech. 15, 909–923 (1966; Zbl 0145.21302)] continua in which a mathematical constraint between the micro kinematics description and the usual macrodeformation gradient field has been introduced. This constraint is enforced in a weak sense by the use of Lagrange multipliers in order to avoid difficulties with the C1 continuity, for the finite element method. Corresponding finite elements are then constructed involving the Lagrange multipliers field. A geometrically nonlinear 2-D finite element code is developed within a framework of an incremental method. For every step, a full Newton-Raphson involving a numerical consistent tangent stiffness operator for the complete model (i.e., the second gradient terms as well as the classical ones) is done and some numerical tests allow to validate the method and to discuss the influence of the geometrical nonlinearity.

MSC:

74S05 Finite element methods applied to problems in solid mechanics
74C15 Large-strain, rate-independent theories of plasticity (including nonlinear plasticity)

Keywords:

localization; large strain; second gradient plasticity model; Lagrange multipliers; F.E.M.

Full Text: DOI

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