Dal Maso, Gianni; **Heltai, Luca**

A numerical study of the jerky crack growth in elastoplastic materials with localized plasticity. (English) Zbl 1471.65183

J. Convex Anal. 28, No. 2, 535-548 (2021).

The authors present a numerical implementation of a model of quasi-static crack growth in linearly elastic-perfectly plastic materials. By assuming that the displacement is antiplane, and that the cracks and the plastic slips are localized on a prescribed path, a numerical evidence of the fact that the crack growth is intermittent, with jump characteristics that depend on the material properties, is provided.

Reviewer: Abdallah Bradji (Annaba)

MSC:

65N22	Numerical solution of discretized equations for boundary value problems involving PDEs
65N30	Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs
35J05	Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation
35J25	Boundary value problems for second-order elliptic equations
74A45	Theories of fracture and damage
74C05	Small-strain, rate-independent theories of plasticity (including rigid-plastic and elasto-plastic materials)
74B10	Linear elasticity with initial stresses
74R10	Brittle fracture

Keywords:

fracture mechanics; plasticity; quasistatic evolution; rate-independent problems; finite element method

Software:

deal2lkit; deal.ii

Full Text: arXiv Link

References:

[1] D. Arndt, W. Bangerth, T. C. Clevenger, D. Davydov, M. Fehling, D. Garcia-Sanchez, G. Harper, T. Heister, L. Heltai, M. Kronbichler, R. Maguire Kynch, M. Maier, J. P. Pelteret, B. Turcksin, D. Wells:The deal.II library, Version 9.1, J. Numer. Math. 27/4 (2019) 203-213. · Zbl 1435.65010

[2] D. Arndt, W. Bangerth, D. Davydov, T. Heister, L. Heltai, M. Kronbichler, M. Maier, J.-P. Pelteret, B. Turcksin, D. Wells:The deal.II finite element library: Design, features, and insights, Comp. Math. Appl. 81 (2021) 407-422. · Zbl 07288721

[3] S. Brach, E. Tanné, B. Bourdin, K. Bhattacharya:Phase-field study of crack nucleation and propagation in elastic-perfectly plastic bodies, Comp. Meth. Appl. Mech. Engineering 353 (2019) 44-65. · Zbl 1441.74201

[4] P. G. Ciarlet:The Finite Element Method for Elliptic Problems, Classics in Applied Mathematics 40, SIAM, Philadelphia (2002). · Zbl 0999.65129

[5] G. Dal Maso, R. Toader:Quasistatic crack growth in elasto-plastic materials: The two-dimensional case, Arch. Rational Mech. Analysis 196/3 (2010) 867-906. · Zbl 1304.74005

[6] G. Dal Maso, R. Toader:On the jerky crack growth in elastoplastic materials, Calc. Var. Partial Diff. Equations 59 (2020), art. no. 107. · Zbl 1443.74255

[7] L. De Lorenzis, A. McBride, B. D. Reddy:Phase-field modelling of fracture in single crystal plasticity, GAMM-Mitteilungen 39/1 (2016) 7-34. · Zbl 1397.74031

[8] Y. Descatha, P. Ledermann, J. C. Devaux, F. Mudry, A. Pineau, J. C. Lautridou:Experimental and numerical study of the different stages in ductile rupture - Application

[9] A. Ern, J.-L. Guermond:Theory and Practice of Finite Elements, Applied Mathematical Sciences 159, Springer, Berlin (2004).

· Zbl 1059.65103

[10] D. Hull:Fractography Observing, Measuring and Interpreting Fracture Surface Topography, Cambridge Univerty Press, Cambridge (1999).

[11] J. W. Hutchinson:A Course on Nonlinear Fracture Mechanics, Department of Solid Mechanics, Technical University of Denmark (1979).

[12] A. Mielke, T. Roubiček:Rate-Independent Systems. Theory and Application, Springer, New York (2015). · Zbl 1339.35006

[13] M. Ortiz, A. Pandolfi:Finite-deformation irreversible cohesive elements for threedimensional crack-propagation analysis, Int. J. Numer. Meth. Engineering 44/9 (1999) 1267-1282. · Zbl 0932.74067

[14] J. R. Rice:Mathematical analysis in the mechanics of fracture, Math. Fundamentals 2/B2 (1968) 191-311.

[15] J. R. Rice, E. P. Sorensen:Continuing crack-tip deformation and fracture for planestrain crack growth in elastic-plastic solids, J. Mech. Physics Solids 26/3 (1978) 163-186. · Zbl 0384.73066

[16] A. Sartori, N. Giuliani, M. Bardelloni, L. Heltai:deal2lkit: A toolkit library for high performance programming in deal.II, SoftwareX 7 (2018) 318-327.

[17] L. R. Scott, S. Zhang:Finite element interpolation of nonsmooth functions satisfying boundary conditions, Math. Computation 54/190 (1990) 483. · Zbl 0696.65007

[18] D. Wick, T. Wick, R. J. Hellmig, H.-J. Christ:Numerical simulations of crack propagation in screws with phase-field modeling, Comp. Materials Sci. 109 (2015) 367