Gu, X. B.; **Wu, Q. H.**

The application of nonordinary, state-based peridynamic theory on the damage process of the rock-like materials. (English) Zbl 1400.74074

Math. Probl. Eng. 2016, Article ID 9794605, 9 p. (2016).

Summary: Peridynamics has a great advantage over modeling the damage process of rock-like materials, which is assumed to be in a continuum interaction with each other across a finite distance. In the paper, an approach to incorporate classical elastic damage model in the nonordinary, state-based peridynamics is introduced. This method can model the dynamic damage process and stress change of rock-like materials. Then two instances about three-point bend experiment are simulated in the rock-like materials. Finally the conclusions are drawn that numerical results are close to the experimental results. So the method has a great predictable value in the geotechnical engineering.

Reviewer: Reviewer (Berlin)

MSC:

74L10 Soil and rock mechanics
74A45 Theories of fracture and damage

Full Text: DOI

References:

[1] Moës, N.; Dolbow, J.; Belytschko, T., A finite element method for crack growth without remeshing, International Journal for Numerical Methods in Engineering, 46, 1, 131-150, (1999) · Zbl 0955.74066

[2] Belytschko, T.; Black, T., Elastic crack growth in finite elements with minimal remeshing, International Journal for Numerical Methods in Engineering, 45, 5, 601-620, (1999) · Zbl 0943.74061

[3] Wagner, G. J.; Moës, N.; Liu, W. K.; Belytschko, T., The extended finite element method for rigid particles in Stokes flow, International Journal for Numerical Methods in Engineering, 51, 3, 293-313, (2001) · Zbl 0998.76054

[4] Belytschko, T.; Krongauz, Y.; Organ, D., Meshless methods: an overview and recent developments, Computer Methods in Applied Mechanics and Engineering, 139, 1–4, 3-47, (1996) · Zbl 0891.73075

[5] Libersky, L. D.; Petsehek, A. G., Smooth particle hydrodynamics with strength of materials, Advances in the Free-Lagrange Method Including Contributions on Adaptive Gridding and the Smooth Particle Hydrodynamics Method: Proceedings of the Next Free-Lagrange Conference Held at Jackson Lake Lodge, Moran, WY, USA 3–7 June 1990. Advances in the Free-Lagrange Method Including Contributions on Adaptive Gridding and the Smooth Particle Hydrodynamics Method: Proceedings of the Next Free-Lagrange Conference Held at Jackson Lake Lodge, Moran, WY, USA 3–7 June 1990, Lecture Notes in Physics, 395, 26-248, (1990), Berlin, Germany: Springer, Berlin, Germany

[6] Silling, S. A., Reformulation of elasticity theory for discontinuities and long-range forces, Journal of the Mechanics and Physics of Solids, 48, 1, 175-209, (2000) · Zbl 0970.74030

[7] Silling, S. A.; Bobaru, F., Peridynamic modeling of membranes and fibers, International Journal of Non-Linear Mechanics, 40, 2-3, 395-409, (2005) · Zbl 1349.74231

[8] Silling, S. A.; Bathe, K. J., Dynamic fracture modeling with a meshfree peridynamic code, Computational Fluid and Solid Mechanics, 641-644, (2003), Amsterdam, The Netherlands: Elsevier, Amsterdam, The Netherlands

[9] Askari, E.; Xu, J.; Silling, S., Peridynamic analysis of damage and failure in composites, Proceedings of the 44th AIAA Aerospace Sciences Meeting and Exhibit (AIAA '06)

[10] Colavito, K. W.; Kilic, B.; Celik, E.; Madenci, E.; Askari, E.; Silling, S. A., Effect of void content on stiffness and strength of composites by a peridynamic analysis and static indentation test, Proceedings of the 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference

[11] Colavito, K. W.; Kilic, B.; Celik, E.; Madenci, E.; Askari, E.; Silling, S., Effect of nano particles on stiffness and impact strength of composites, Proceedings of the 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference

[12] Jung, J.; Soek, J., Fatigue crack growth analysis in layered heterogeneous material systems using peridynamic approach, Composite Structures, 152, 403-407, (2016)

[13] Xu, J.; Askari, A.; Weckner, O.; Razi, H.; Silling, S., Damage and failure analysis of composite laminates under biaxial loads, Proceedings of the 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, AIAA

[14] Foster, J. T.; Silling, S. A.; Chen, W. W., Viscoplasticity using peridynamics, International Journal for Numerical Methods

in Engineering, 81, 10, 1242-1258, (2010) · Zbl 1183.74035

[15] Wu, C. T.; Ren, B., A stabilized non-ordinary state-based peridynamics for the nonlocal ductile material failure analysis in metal machining process, Computer Methods in Applied Mechanics and Engineering, 291, 197-215, (2015)

[16] Wu, C. T.; Ma, N.; Takada, K.; Okada, H., A meshfree continuous-discontinuous approach for the ductile fracture modeling in explicit dynamics analysis, Computational Mechanics, 58, 3, 391-409, (2016) · Zbl 1398.74480

[17] Sun, S.; Sundararaghavan, V., A peridynamic implementation of crystal plasticity, International Journal of Solids and Structures, 51, 19-20, 3350-3360, (2014)

[18] Gerstle, W.; Sau, N.; Silling, S., Peridynamic modeling of concrete structures, Nuclear Engineering and Design, 237, 12-13, 1250-1258, (2007)

[19] Ha, Y. D.; Lee, J.; Hong, J.-W., Fracturing patterns of rock-like materials in compression captured with peridynamics, Engineering Fracture Mechanics, 144, 176-193, (2015)

[20] Weckner, O.; Abeyaratne, R., The effect of long-range forces on the dynamics of a bar, Journal of the Mechanics and Physics of Solids, 53, 3, 705-728, (2005) · Zbl 1122.74431

[21] Zhou, X.-P.; Gu, X.-B.; Wang, Y.-T., Numerical simulations of propagation, bifurcation and coalescence of cracks in rocks, International Journal of Rock Mechanics \& Mining Sciences, 80, 241-254, (2015)

[22] Jenq, Y. S.; Shah, S. P., Mixed-mode fracture of concrete, International Journal of Fracture, 38, 2, 123-142, (1988)

[23] Haeri, H.; Shahriar, K.; Marji, M. F.; Moarefvand, P., Experimental and numerical study of crack propagation and coalescence in pre-cracked rock-like disks, International Journal of Rock Mechanics and Mining Sciences, 67, 20-28, (2014)