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Finite dynamical uniaxial strain of nonlinear elastic solids: an exact solution

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Abstract. The uniaxial dynamical equation of nonlinear elasticity is solved for the case of finite strains. A partial exact solution is found for the case when the material properties are described by the Blatz–Ko strain energy function.

Keywords: nonlinear dynamics, finite strains, one-dimensional problem, exact solution
MSC numbers: 74B20, 74H05

References

[1] Blatz P.J. and Ko W.L. *Applications of finite elasticity theory to deformation of rubbery materials.* Trans. Soc. Rheol. 1962, **6**, pp. 223–251

[2] Dai H.-H. and Huo Y. *Solitary shock waves and other travelling waves in a general compressible hyperelastic rod.* Proc. Roy. Soc. London A 2000, **456**, pp. 331–363

[3] Destrade M. *Finite-amplitude inhomogeneous plane waves in a deformed Mooney-Rivlin material.* Quarterly Journal of Mechanics and Applied Mathematics 2000, **53**, pp. 343-–361

[4] Hill J.M. and Wegner J.L. *New families of exact nonlinear waves for the neo-Hookean finite elastic solid.* Mathematics and Mechanics of Solids 2004, **9**, pp. 81–95

[5] Knowles J.K. *Large amplitude oscillations of a tube of incompressible elastic material.* Q. Appl. Math. 1960. **18**, pp. 71–77

[6] Levin V.A. and Vershinin A.V. *Non-stationary plane problem of the successive origination of stress concentrators in a loaded body. Finite deformations and their superposition.* Communications in Numerical Methods in Engineering 2008, **24**, pp. 2229–2239

[7] Lurie A.I. *Nonlinear theory of elasticity.* 1990, Amsterdam: North-Holland

[8] Miroshnichenko A.E., Vasiliev A.A., Dmitriev S.V. and Shigenari T. *Inelastic three-soliton collisions in a weakly discrete sine-Gordon system.* Nonlinearity 2000, **13**, No. 3. pp. 837–848

[9] Murnaghan F.D. *Finite deformation of an elastic solid.* 1951, New York: Wiley, 140pp.

[10] Samsonov A.M. *Strain solitons in solids and how to construct them.* 2001, Chapman & Hall/CRC Press, 227pp.

[11] Sedov L.I. *Similarity and Dimensional Methods in Mechanics, Tenth Edition.* 1993, CRC Press, 496pp.

[12] Zingerman K.M. *Exact solution of one dynamic problem in the elasticity theory under finite strains.* 2013, Vestnik TvGU. Seriya: Prikladnaya matematika [Herald of Tver State University. Series: Applied Mathematics], No. 3(30), pp. 19–25 (in Russian)