Title:

Mathematical analysis and computer simulations of deformation of nonlinear elastic bodies in the small strain range.

Author:

Vojtěch Kulvait

Department:

Mathematical Institute of Charles University

Supervisor:

prof. RNDr. Josef Málek, CSc., Dsc.

Abstract:

Implicit constitutive theory provides a suitable theoretical framework for elastic materials that exhibit a nonlinear relationship between strain and stress in the range of small strains. We study a class of power-law models, where the nonlinear dependence of strain on the deviatoric part of the stress tensor and its trace are mutually separated. We show that these power-law models are capable to describe the response of a wide variety of beta phase titanium alloys in the small strain range and that these models fit available experimental data exceedingly well. We also develop a mathematical theory regarding the well-posedness of boundary value problems for the considered class of power-law solids. In particular, we prove the existence of weak solutions for power law exponents in the range $(1, \infty)$. Finally, we perform computer simulations for these problems in the anti-plane stress setting focusing on the V-notch type geometry. We study the dependence of solutions on the values of power law exponents and on the V-notch opening angle. We achieve satisfactory results regarding the global stability of computed solutions.