

Explosive Instabilities in a Class of Hyperelastic Materials with Higher-Order Gradients

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We establish a continuum mechanics framework for three-dimensional analysis for the onset of material instability in second-gradient hyperelasticity based on a linear stability analysis of governing field equations. The essence of the method presented in the paper is to consider an evolution of exponential disturbances and their growth or decay from homogeneous states, which are defined by a set of relations describing isothermal hyperelastic behavior of the material with the second-gradient type of deformation. Instability develops as a result of explosive growth of imposed disturbance of governing field equations. If the material in the elastic range exhibits a certain amount of non-local interaction with surroundings, the velocity dependence of propagating waves through such a medium depends on the wavelength and it is non-trivial. Consequently, special attention must be given to the detection of critical conditions leading to the standard and the symmetry breaking bifurcation. We display a derivation of a general dispersion relation of the expanded stability equation and also discuss some particular issues regarding critical conditions leading to the spatial heterogeneity in the evolution of fluctuation.

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