# Bifurcation of the free surface of a rectangular block with second-gradient nonlinear elasticity

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**Abstract**

We are motivated by the formation of spatially localized deformations, known as creases, on the surface of soft elastic solids subjected to compressive loading. From the celebrated work of Biot (1963), it is well known that the flat surface of a hyperelastic half-space necessarily forms wrinkles at the critical buckling load. However, the wavelength of the wrinkles at this critical load is arbitrary. This corresponds to the failure of complimenting condition for a boundary value problem involving a traction-free surface (Negrón-Marrero and E.L. Montes-Pizarro (2011)). To overcome this degeneracy, bifurcations problems for a non-homogeneous solids, such as a functionally graded materials or a thin stiff film bonded to the surface of the soft solids are studied in the literature (Pandurangi et al. (2022)).
In this work, we will consider the bifurcations of rectangular block of non-simple material whose strain energy density depends on the first and second gradient of deformation. The second gradient term is assumed to have a quadratic form multiplying a small scalar parameter. The block is subjected to an axially compressive load with sliding boundary conditions at the two ends. We are interested in the bifurcations of the free surface from its initial flat state. After introducing the boundary value problem, we discuss the linearization of the equations about the trivial line of solutions corresponding to the homogeneous solution. The local bifurcation analysis will be presented.

References:

M. A. Biot, "Surface instability of rubber in compression", Applied Scientific Research, Section A, 12(2):168–182, 1963

P. V. Negrón-Marrero and E.L. Montes-Pizarro, "The complementing condition and its role in a bifurcation theory applicable to nonlinear elasticity". New York Journal of Mathematics 17a:245–265, 201.
S. S. Pandurangi, A. Akerson, R. S. Elliott, T. J. Healey and N. Triantafyllidis, "Nucleation of creases and folds in hyperelastic Solids is Not a Local Bifurcation", Journal of the Mechanics and Physics of Solids, 160:104749, 2022.

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