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Title:

**Local Bifurcation Analysis of a Second Gradient Model for Deformations of a Rectangular Slab**

**Abstract:**

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In this paper we carry out a derivation of the equilibrium equations of two dimensional nonlinear elasticity with an added second--gradient term proportional to a small parameter  $\varepsilon > 0$ . These equations are given by a fourth order semilinear system of pde's. We discuss different types of possible boundary conditions for these equations. We then specialize the equations to a rectangular slab and study the linearized problem about a homogenous deformation. We show that these equations admit solutions representable as Fourier series in one of the independent variables. Furthermore, we obtain the characteristic equation for the eigenvalues (possible bifurcation points) for the linear problem and derive asymptotic representations for this equation for small  $\varepsilon$ . We used these expressions to show that in the limit as  $\varepsilon \rightarrow 0$  the characteristic equation for  $\varepsilon > 0$  converges uniformly (in certain regions of the parameter space) to the corresponding characteristic equation for  $\varepsilon = 0$ . When the base material ( $\varepsilon = 0$ ) is that of a Blatz--Ko type, we get conditions for the existence of eigenvalues of the linear problem with  $\varepsilon > 0$  and small. Our numerical results in this case indicate that the number of bifurcation points is finite when  $\varepsilon > 0$  and that this number monotonically increases as  $\varepsilon \rightarrow 0$ . For the problem with  $\varepsilon > 0$  we get conditions for the existence of local branches of non--trivial solutions.