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Dynamics of Nonlinear Longitudinal Vibrations in a 1D Nano-Scale Continuum Described by the Generalized Morse Potential

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Abstract: A continuum which was described by a governing second-order partial differential equation (PDE), containing an infinite attachment of atoms, was detailed. We formulated the governing PDE using Hamilton's principle and derived the boundary conditions. Four different boundary conditions were formulated but we assumed that the left end of the continuum was fixed, $u(t, r = 0) = 0$, while the right end was free, $\left.\frac{\partial u}{\partial r}\right|_{r=l} = 0$. The method of lines was employed and used to convert the governing PDE into a coupled system of infinite ordinary differential equations (ODEs). The system of coupled ODEs was numerically integrated within the time interval, $t \in [0, 4\pi]$. It was observed that the trough of the waves became sharply triangular for lower grid points and smooth for higher grid points.

Keywords: *generalized Morse potential; Hamilton's principle; method of lines; nonlinear interactions; periodic motion.*

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