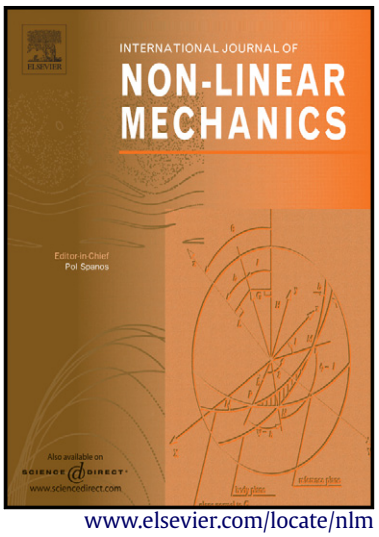

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ANALYSIS OF SUBCOMBINATION INTERNAL RESONANCES IN A NONLINEAR CANTILEVER BEAM OF VARYING ORIENTATION WITH TIP MASS

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In this study, sub-combination internal resonance of a uniform cantilever beam of varying orientation with a tip mass under vertical base excitation was investigated. The Euler–Bernoulli theory for the slender beam was used to derive the governing non-linear partial differential equation. The governing equation, which retains the cubic non-linearities of geometric and inertial type, was discretised using Galerkin's method. The resulting second-order temporal differential equation was then reduced by the method of multiple scales to a set of first order six nonlinear ordinary-differential equations, governing the amplitudes and phases of the three interacting modes. Both frequency-response and force-response curves were plotted for the case $\Omega \approx \omega_4 = \frac{1}{2}(\omega_2 + \omega_5)$.

Two possible responses occurred: single-mode and three-mode responses. The single-mode periodic response was observed to undergo supercritical and subcritical pitchfork bifurcations, which caused three-mode interactions. In the event of three-mode responses, there are conditions for which the low-frequency mode become effective over the response, resulting in high-amplitude oscillations.

Keywords: cantilever beams, tip mass, subcombination internal resonance