Stochastic Response of Beams Equipped with Tuned Mass Dampers, Considering Spring Inertial Effects, Subjected to Poissonian Loads

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Abstract

This contribution considers the dynamic response of Euler-Bernoulli beams equipped with multiple tuned mass dampers, subjected to random moving loads following a Poissonian. The method proposed for the mathematical solution utilises the theory of generalised functions to find the response variables at the exact locations of the discontinuities, in this case, tuned mass damper attachments. This involves deriving exact, complex eigenvalues and eigenfunctions from a characteristic equation built as the determinant of a (4 x 4) matrix as oppose to the classical method requiring an (n+1 x n+1) for n number of attachments. This is always the case, in the proposed method, regardless of the number or type of attachments. Orthogonality conditions are then built for the eigenfunctions and then, the stochastic response of the beam under Poissonian loading is evaluated. To show the applicability and accuracy of the proposed procedure, a numerical application is presented in which a beam with multiple tuned mass dampers, acted upon by random moving loads, in the form of a filtered Poissonian process. The means and standard deviations at the midpoint are presented for various beam models fitted with different numbers of tuned mass damper attachments, these are found by employing a Monte- Carlo simulation.