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Dynamic Analysis of Functionally Graded Nano Composite Pipe with PZT Layers Subjected to Moving Load

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Abstract : In this study, dynamic analysis of functionally graded nano-composite pipe reinforced by single-walled carbon nano-tubes (SWCNTs) with simply supported boundary condition subjected to moving mechanical loads is investigated. The material properties of functionally graded carbon nano tube-reinforced composites (FG-CNTRCs) are assumed to be graded in the thickness direction and are estimated through a micro-mechanical model. In this paper polymeric matrix considered as isotropic material and for the CNTRC, uniform distribution (UD) and three types of FG distribution patterns of SWCNT reinforcements are considered. The system equation of motion is derived by using Hamilton's principle under the assumptions of first order shear deformation theory (FSDT).The thin piezoelectric layers embedded on inner and outer surfaces of FG-CNTRC layer are acted as distributed sensor and actuator to control dynamic characteristics of the FG-CNTRC laminated pipe. The modal analysis technique and Newmark's integration method are used to calculate the displacement and dynamic stress of the pipe subjected to moving loads. The effects of various material distribution and velocity of moving loads on dynamic behavior of the pipe is presented. This present approach is validated by comparing the numerical results with the published numerical results in literature. The results show that the above-mentioned effects play very important role on dynamic behavior of the pipe .This present work shows that some meaningful results that which are interest to scientific and engineering community in the field of FGM nano-structures.

Keywords : nano-composite, functionally garded material, moving load, active control, PZT layers
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