عنوان مقاله:

Nonlinear coupled torsional-radial vibration of single-walled carbon nanotubes using numerical methods

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خلاصه مقاله:

This paper analyzes the nonlinear coupled torsional-radial vibration of single-walled carbon nanotubes (SWCNTs) based on numerical methods. Two partial differential equations that govern the nonlinear coupled torsional-radial vibration for such nanotube are derived using doublet mechanics (DM) principles. First, these equations are reduced to ordinary differential equations using Galerkin method and then solved using homotopy perturbation method (HPM) to obtain the nonlinear natural frequencies in coupled torsional-radial vibration mode. It is found that the obtained frequencies are complicated due to coupling between two vibration modes. The dependence of boundary conditions, vibration modes and nanotubes geometry on the nonlinear coupled torsional-radial vibration characteristics of SWCNTs are studied in details. It was shown that boundary conditions and maximum vibration velocity have significant effects on the nonlinear coupled torsional-radial vibration response of SWCNTs. It was also seen that unlike the linear model, as the maximum vibration velocity increases, the natural frequencies of vibration increase too. To show the effectiveness and ability of this method, the results obtained with the present method are compared with the fourth order Runge-Kuta numerical results and good agreement is observed. To the knowledge of authors, the .results given herein are new and can be used as a basic work for future papers

کلمات کلیدی:

Homotopy Perturbation Method, nonlinear coupled torsional-radial vibration, single-walled carbon nano-tubes, natural frequency