عنوان مقاله:

Natural Frequency of Rotating Single-Walled Carbon Nanotubes with Considering Gyroscopic Effect

محل انتشار:

فصلنامه مکانیک جامد, دوره 12, شماره 1 (سال: 1399)

تعداد صفحات اصل مقاله: 12

نویسندگان:

A Fatahi-Vajari - *Department of Mechanical Engineering, Shahryar Branch, Islamic Azad University, Shahryar, Iran*

Z Azimzadeh - *Young Researchers and Elite Club, Yadegar-e-Imam Khomeini (RAH) Shahr-e-Rey Branch, Islamic Azad University, Tehran, Iran*

خلاصه مقاله:

This paper investigates the bending vibration of rotating single-walled carbon nanotubes (SWCNTs) based on nonlocal theory. To this end, the rotating SWCNTs system modeled as a beam with a circular cross section and the Euler-Bernoulli beam theory (EBT) is applied with added effects such as rotary inertia, gyroscopic effect and rotor mass unbalance. Using nonlocal theory, two coupled sixth order partial differential equations that govern the vibration of rotating SWCNTs are derived. To obtain the natural frequency and dynamic response of the nanorotor system, the equation of motion for the rotating SWCNTs are solved. It is found that there are two frequencies in the frequency spectrum. The positive rootintroduced as forward whirling mode, while the negative root represents backward whirling mode. The detailed mathematical derivations are presented while the emphasis is placed on investigating the effect of the several parameters such as, tube radius, angular velocity and small scale parameter on the vibration behavior of rotating nanotubes. It is explicitly shown that the vibration of a spinning nanotube is significantly influenced by these effects. To validate the accuracy and efficiency of this work, the results obtained herein are compared with the existing theoretical and experimental results and good agreement is observed. To the knowledge of authors, the vibration of rotating SWCNTs considering gyroscopic effect has not investigated analytically yet and then the results generated herein can be served as a benchmark for future works.

کلمات کلیدی:

Nonlocal theory, Gyroscopic effect, Forward and backward natural frequencies, Scale parameter, Rotating single-walled carbon nanotubes