Onset of Regular and Chaotic Motion in Hybrid Casson Nanofluid Saturated in Rotating Anisotropic Porous Medium

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Abstract

The present article aims to investigate the onset of regular motion and the development of chaotic motion in the hybrid Casson nanofluid suspension. The flow dynamics are modeled using the modified Buongiorno model, incorporating the effects of non-uniform internal heating, anisotropic porous medium, and rotation. The onset of regular motion is studied by employing linear stability analysis, while weak nonlinear stability analysis is carried out to quantify the heat and mass transfer rates. Furthermore, the Lorenz model is solved to study the development of chaotic motion. For this purpose, the Hopf Rayleigh number and maximum Lyapunov exponent are calculated. The outcomes reveal that the Casson base fluid and rotation delay the convection process, whereas the heat source hastens the convection process. A high heat transfer rate can be accomplished by placing the fluidic system in a rotating anisotropic porous medium with larger mechanical anisotropy. Chaotic motion develops earlier for the fluidic layer placed in a non-rotating reference frame.

Keywords: Hybrid Casson Nanofluid, Rotation, Anisotropic Porous Medium, Chaotic Motion