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MHD mixed convection in a nanofluid filled vertical lid-driven cavity having a flexible fin attached to its upper wall
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Abstract
In this study, fluid flow and heat transfer in a vertical lid-driven CuO–water nanofluid filled square cavity with a flexible fin attached to its upper wall under the influence of an inclined magnetic field are numerically investigated. The left vertical wall of the cavity is colder than right vertical wall, and it moves in + y direction with constant speed. Horizontal walls of the cavity are insulated. The governing equations are solved with finite element method. The arbitrary Lagrangian–Eulerian method is used to describe the fluid motion within the cavity for the flexible fin in the fluid-structure interaction model. The influence of Richardson number (between 0.01 and 100), Hartmann number (between 0 and 50), inclination angle of the magnetic field (between 0 and 90%), nanoparticle volume fraction (between 0 and 0.05) and Young's modulus of flexible fin (between 250 and 5000) on the flow and heat transfer were numerically studied. It is observed that the presence of the elastic fin affects the flow field and thermal characteristics of the cavity. The local and average heat transfer enhance as the Richardson number, solid volume fraction of the nanoparticle increase whereas deteriorate as the value of the Hartmann number and inclination angle of the magnetic field increases due to the dampening of the fluid motion with Lorentz forces. The addition of the nanoparticles is more effective along the lower part of the right vertical wall where the heat transfer process is effective. The average heat transfer increases by 28.96% for solid volume fraction of 0.05% compared to base fluid when the flexible fin is attached to the upper wall. The average heat transfer deteriorates by 10.10% for cavity with and without fin at Hartmann number of 50 compared to the case without magnetic field. The average heat transfer enhances as the Young's modulus of the flexible fin decreases and the average Nusselt number increases by 13.24% for Young's modulus of 250 compared to configuration for the cavity having the Young's modulus of 5000. © 2018, Akadémiai Kiadó, Budapest, Hungary.

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