PAPER

Analyzing the effect of uncertainty on hybrid permeable nanofluid flow under thermal radiation by Gaussian and triangular fuzzy numbers

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Abstract

This paper investigates the magnetohydrodynamic hybrid nanofluid flow between two non-parallel walls, consisting of $Cu-Ag$ nanoparticles suspended in H_2O as the base fluid, which stretch or shrink under the influence of heat transfer with a heat source/sink. This analysis considers the impact of thermal radiation and porous media on the velocity and temperature profiles. The analysis is relevant in engineering applications such as cooling systems, lubrication, and advanced material manufacturing where precise heat and flow control are crucial. The nanoparticle volume fraction is modeled as an uncertain parameter, using Gaussian and triangular fuzzy numbers, specifically GFN(0.025, 0.01, 0.01) and TFN(0, 0.025, 0.05). A double parametric approach for fuzzy numbers, along with the homotopy method, is employed to investigate the uncertain effects of key physical parameters such as the stretching/shrinking parameter, Reynolds number, magnetic parameter, Darcy number, Eckert number, radiation parameter, and the volume fraction of nanoparticles on the fuzzy velocity and temperature profiles of the hybrid nanofluid flow in convergent and divergent channels. The numerical results are validated through experimentation, demonstrating strong agreement in both the crisp and uncertain scenarios using triangular and Gaussian fuzzy senses, and showing consistency with previously established findings.

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Next article in issue →

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