World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:17, No:10, 2023

Chebyshev Collocation Method for Solving Heat Transfer Analysis for Squeezing Flow of Nanofluid in Parallel Disks

Authors : Mustapha Rilwan Adewale, Salau Ayobami Muhammed

Abstract : This study focuses on the heat transfer analysis of magneto-hydrodynamics (MHD) squeezing flow between parallel disks, considering a viscous incompressible fluid. The upper disk exhibits both upward and downward motion, while the lower disk remains stationary but permeable. By employing similarity transformations, a system of nonlinear ordinary differential equations is derived to describe the flow behavior. To solve this system, a numerical approach, namely the Chebyshev collocation method, is utilized. The study investigates the influence of flow parameters and compares the obtained results with existing literature. The significance of this research lies in understanding the heat transfer characteristics of MHD squeezing flow, which has practical implications in various engineering and industrial applications. By employing the similarity transformations, the complex governing equations are simplified into a system of nonlinear ordinary differential equations, facilitating the analysis of the flow behavior. To obtain numerical solutions for the system, the Chebyshev collocation method is implemented. This approach provides accurate approximations for the nonlinear equations, enabling efficient computations of the heat transfer properties. The obtained results are compared with existing literature, establishing the validity and consistency of the numerical approach. The study's major findings shed light on the influence of flow parameters on the heat transfer characteristics of the squeezing flow. The analysis reveals the impact of parameters such as magnetic field strength, disk motion amplitude, fluid viscosity on the heat transfer rate between the disks, the squeeze number(S), suction/injection parameter(A), Hartman number(M), Prandtl number(Pr), modified Eckert number(Ec), and the dimensionless length(δ). These findings contribute to a comprehensive understanding of the system's behavior and provide insights for optimizing heat transfer processes in similar configurations. In conclusion, this study presents a thorough heat transfer analysis of magneto-hydrodynamics squeezing flow between parallel disks. The numerical solutions obtained through the Chebyshev collocation method demonstrate the feasibility and accuracy of the approach. The investigation of flow parameters highlights their influence on heat transfer, contributing to the existing knowledge in this field. The agreement of the results with previous literature further strengthens the reliability of the findings. These outcomes have practical implications for engineering applications and pave the way for further research in related areas.

Keywords : squeezing flow, magneto-hydro-dynamics (MHD), chebyshev collocation method(CCA), parallel manifolds, finite difference method (FDM)
Conference Title : ICFM 2023 : International Conference on Fluid Mechanics
Conference Location : Barcelona, Spain
Conference Dates : October 23-24, 2023