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NUMERICAL SOLUTION OF TIME-DEPENDENT MICROPOLAR NANOFLUID FLOW OVER A LINEAR CURVED STRETCHING SURFACE USING BVP4C

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ABSTRACT

This study focuses on the time-dependent flow of a micropolar nanofluid over a linear curved stretching surface, aiming to improve the numerical approach for solving heat transfer problems. Since the governing equations are nonlinear partial differential equations (PDEs), similarity transformations were applied to reduce them into a set of ordinary differential equations (ODEs), which are easier to handle. These ODEs were then solved using the BVP4C solver in MATLAB, which is known for its ability to handle boundary value problems accurately. The study explores the effects of several physical parameters such as micropolar, curvature, unsteadiness, Brownian motion, thermophoresis, stretching and thermal slip on the fluid's momentum, energy and concentration profiles. A dimensionless form of the equations was used, based on boundary layer assumptions, to simplify the modelling process. The results reveal that the momentum profile decreases with increasing micropolar parameter, while it increases with both curvature and unsteadiness parameters. For the energy profile, the temperature was found to decrease with increasing thermal slip and stretching parameters. Meanwhile, the concentration profile shows a decreasing trend with higher Brownian motion and curvature values. These findings highlight the effectiveness of BVP4C in solving nonlinear systems and provide valuable insight into how different physical parameters influence the flow, temperature, and concentration behaviour. A comparison with results from shooting method was also made to validate the accuracy of this approach. Overall, the findings contribute to a better understanding of micropolar nanofluid flow over curved surfaces and the use of numerical methods in fluid mechanics.

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