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A novel simple algorithm for solving the magneto-hemodynamic flow in a semi-porous channel

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Abstract

In this paper, we propose a simple and easy-to-implement numerical algorithm based on the $GL_6(\mathbb{R})$ Lie group, for the solution of magneto-hemodynamic (MHD) flow in a semi-porous channel by transforming the governing equations into a nonlinear system of six first-order ordinary differential equations (ODEs). Innovative Lie-group method, allows us to search missing initial slopes at the left-ends, and moreover, the initial slopes can be expressed as closed-form functions of $r \in (0, 1)$, where the best r is determined by matching the right-end boundary conditions. The influence of transpiration Reynolds number (mass transfer parameter, Re) and Hartmann number (H) on the velocity profiles in the channel are considered graphically. Finally, the reported results are compared with those calculated by numerical method (NM) which illuminate the efficiency and precision of $GL_6(\mathbb{R})$ Lie group method for this problem.

Key words: $GL_6(\mathbb{R})$ Lie group; magneto-hemodynamic flow; semi-porous channel.

1 Introduction

The concept of Lie groups is very helpful in constructing some new potent approximate methods to integrate ordinary differential equations (ODEs), which preserve the invariant property. In this field of applied mathematics, a fundamental concept in the minimization of numerical errors is preserving the Lie group structure under discretization. Therefore, by sharing the geometric structure and invariance of the original ODEs, new schemes can be devised, which are more accurate, stable and

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