A New Lie Group Integrator to Solve the Forced Convection in a Porous-saturated Duct

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Abstract

The concept of Lie groups is very helpful in constructing some new potent approximate methods to integrate ordinary differential equations (ODEs), which preserve the Lie group structure. In this field of applied mathematics, a fundamental concept in the minimization of approximation 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 effective than the standard numerical methods [1, 2, 3]. From the class of numerical Lie group methods, the group preserving scheme (GPS), uses the Cayley transformation and the Pade approximations in the augmented Minkowski space M^{n+1} which avoids ghost fixed points and spurious solutions. In this presentation, a Lie group integrator based on SL(2,R), whose calculation is far simpler and easier, is constructed to solve the nonlinear forced convection in a porous-saturated duct. Effects of the porous media shaped parameter, Forchheimer number and viscosity ratio on the solutions are discussed and illustrated by the proposed method. The numerical experiments have shown that the SL(2,R)-shooting method is suitable for solving the forced convection in a porous-saturated duct with high accuracy and efficiency.

References

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