

Abstract

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Lie-Group Method Solution for Two-dimensional Viscous Flow between Slowly Expanding Contracting Walls with Weak Permeability

The non-linear equations of motion describing the laminar, isothermal and incompressible flow in a rectangular domain bounded by two weakly permeable, moving porous walls, which enable the fluid to enter exit during successive expansions contractions, are considered. We apply Lie-group method for determining symmetry reductions of partial differential equations. Lie-group method starts out with a general infinitesimal group of transformations under which given partial differential equations are invariant, then, the determining equations are derived. The determining equations are a set of linear differential equations, the solution of which gives the infinitesimals of the dependent and independent variables. After the group has been determined, a solution to the given partial differential equation may be found from the invariant surface condition such that its solution leads to similarity variables that reduce the number of independent variables in the system. Effect of the permeation Reynolds number Re and the dimensionless wall dilation rate λ on self-axial velocity have been studied both analytically and numerically; the results are plotted.