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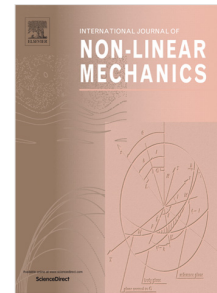
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Approximately invariant solutions of creeping flow equations

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Abstract

In this paper, the steady creeping flow equations of a second grade fluid in cartesian coordinates are considered; the equations involve a small parameter related to the dimensionless non-Newtonian coefficient. According to a recently introduced approach, the first order approximate Lie symmetries of the equations are computed, some classes of approximately invariant solutions are explicitly determined, and a boundary value problem is analyzed. The main aim of the paper is methodological, and the considered mechanical model is used to test the reliability of the procedure in a physically important application.

Keywords: Creeping flow equations, Second grade fluid, Approximate Lie symmetries, Approximately invariant solutions

1. Introduction

Lie theory of continuous transformations provides a unified and powerful approach for handling differential equations [1, 2, 3, 4, 5, 6, 7, 8]. It is known that the knowledge of the Lie point symmetries admitted by ordinary differential equations allows for their order lowering and, possibly, reducing them to quadrature, whereas, in the case of partial differential equations, symmetries can be used for the research of special (invariant) solutions of initial and boundary value problems. Also, the Lie point symmetries are important ingredients in the derivation of conserved quantities, or in the

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