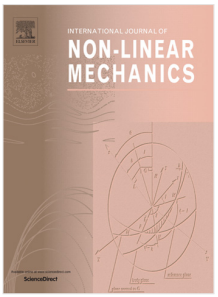
Accepted Manuscript



Approximately invariant solutions of creeping flow equations

Matteo Gorgone

PII: S0020-7462(18)30036-2
DOI: https://doi.org/10.1016/j.ijnonlinmec.2018.05.018
Reference: NLM 3026

To appear in: *International Journal of Non-Linear Mechanics*

Received date : 15 January 2018
Revised date : 22 May 2018
Accepted date : 23 May 2018

Please cite this article as: M. Gorgone, Approximately invariant solutions of creeping flow equations, *International Journal of Non-Linear Mechanics* (2018), https://doi.org/10.1016/j.ijnonlinmec.2018.05.018

Approximately invariant solutions of creeping flow equations

Matteo Gorgone

Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina
Viale F. Stagno d'Alcontres 31, 98166 Messina, Italy

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

Email address: mgorgone@unime.it (Matteo Gorgone)