World Journal of Engineering 7(3) (2010) 93-97

World Journal of
Engineering

Group invariant solutions of evolution equations for composites

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Abstract

Solid-gas reduction and phase change models constitute very important phenomena in composite engineering and scientific technology. Consequently they demand serious attention in respect of solutions which are enduring. This paper addressed the problem of obtaining the solutions of these models which are exact in nature, the prognosis of which surpasses their existing numerical solutions reported in the literature. The Lie group symmetry analysis is succinctly applied to these problems to obtain their infinite Lie point symmetries and corresponding Lie groups of transformations. Further the solution space of each model is obtained. We note that any other solution for each of the model is summarized in its solution space presented.

Key words: *Lie symmetry, Lie groups, Invariant solutions, Equations for composites*

1. Introduction

Multi-scale phenomena include modification of quantum states of materials which are caused by mechanical strains, ferroelectric transformations induced by electric field; mechanical stresses, chemical reaction processes biased by mechanical stresses and change of bio-molecular conformality of proteins caused by environmental mechanical strain rates, etc Complementarity, 2004 are often modeled into differential equations. Some of these differential equations in certain instances are very complex. The complex nature of these models enables simplifications (where over simplification sometimes results to trivialized solutions) otherwise their exact solutions are often difficult to attain. Most times their solutions are numerically in the approximate forms. However Lie (1881) symmetry groups provided classical means of overcoming the lacuna between the modeling of some of these sophisticated scientific problems in composites and their phenomena solutions. The work of Lie (1881) was primarily developed to generalize the method for solving differential equations in a holistic way. The results of Lie (1881) technique have been found to be of wide applications beyond the primary frontiers of his initial idea. This monumental art turns out to be fundamental phenomenon applicable to all spheres of pure and applied mathematics and engineering

ISSN:1708-5284