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Lie symmetries, closed-form solutions, and conservation laws

Title: Lie symmetries, closed-form solutions, and conservation laws of a constitutive equation modeling stress in elastic materials and a technology diffusion model

Abstract:

The Lie-point symmetry method is used to find some closed-form solutions for a constitutive equation modeling stress in elastic materials and a technology diffusion model.

The Lie algebra for the governing PDE system for a constitutive equation modeling stress in elastic materials is five-dimensional. Using the optimal system of one-dimensional subalgebras, closed-form solutions for the model are obtained. Based on the scaling symmetry of the PDE and using Euler and homotopy operators, several conservation laws are computed with symbolic software.

A critical component of economic growth is growth in productivity which is dependent on technology adoption. While most technologies are created in developed economies, they diffuse to developing economies through various channels such as trade, migration and knowledge spillovers. The first model that integrates compartmental models with diffusion is developed to analyze technology adoption within a framework of a system of second-order non-linear partial differential equations. A three-dimensional Lie algebra is established for a technology diffusion model. The combinations of Lie symmetries are used to obtain reductions and establish closed-form solution for the technology diffusion model. The closed-form solutions allow for graphical representations of the technology diffusion process over an effective distance and time and show the commonly observed S-curve path of technology diffusion. Furthermore, a sensitivity analysis is performed to develop policy insights into the factors influencing the diffusion of technology.