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Seema Yadav
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Synopsis

This proceedings contain articles of the various research ideas of the academic community and practitioners presented at the International Conference on Applied Mathematics & Computational Sciences (*ICAMCS 2019*). ICAMCS2019 aimed to provide a platform to discuss ideas, issues, challenges, findings, opportunities, and applications of Applied Mathematics and Computational Sciences in various fields. It is a great privilege for us to present the proceedings of ICAMCS2019 to the authors and the delegates of the event. We hope that you will find it useful, valuable, aspiring, and inspiring.

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On Symmetry Analysis in Finding Solutions of the One Dimensional Wave Equation

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In this paper we obtain the Lie invariance condition for second order partial differential equations. This condition is used to obtain the determining equations of the 1-dimensional wave equation with constant speed. The determining equations are split to obtain an overdetermined system of partial differential equations which are solved to obtain the symmetries of the wave equation. By making an appropriate transformation between the dependent and independent variable, the wave equation is reduced to an easily solvable ordinary differential equation. We solve this resulting differential equation to obtain the solutions of the wave equation. In particular, the one dimensional wave equation with unit speed has been solved.

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On Symmetry Analysis in Finding Solutions of the One Dimensional Wave Equation

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ABSTRACT

In this paper we obtain the Lie invariance condition for second order partial differential equations. This condition is used to obtain the determining equations of the 1-dimensional wave equation with constant speed. The determining equations are split to obtain an overdetermined system of partial differential equations which are solved to obtain the symmetries of the wave equation. By making an appropriate transformation between the dependent and independent variable, the wave equation is reduced to an easily solvable ordinary differential equation. We solve this resulting differential equation to obtain the solutions of the wave equation. In particular, the one dimensional wave equation with unit speed has been solved.

1 Introduction

Over a hundred years ago, Sophus Lie introduced the theory of Lie symmetry groups which are invertible point transformations of the independent and dependent variables in differential equations. In such group analysis, these transformations lead the original differential equation of first order (which may be a complicated one) to becoming a separable one, which can be easily solved. In addition, for higher order differential equations, group analysis of the equation is used to reduce the order of the differential equation by one. A lot of literature on group analysis for ordinary and partial differential equations can be found in [2, 5].

We call transformations leaving objects invariant or unchanged as *Symmetries*. In [16] it is pointed out that symmetries account for various laws in nature, A very important implication of symmetry in physics and mathematics is the existence of conservation laws. This is because their reproduction at different times and places depend on invariance laws. In this connection Emma N*ö*ether [14] observed and proved a relation between continuous symmetries and conservation laws. Scientists like Kepler got interested in studying motion of planets using symmetries while Newton studied the orbits of planets using the laws of mechanics as a symmetry principle.
Partial differential equations are of paramount importance in particle Physics, nonlinear optics, fluid dynamics in addition to its applications in general relativity to differential and algebraic geometry, topology, etc. Research dedicated to using symmetry analysis for partial differential equations arising in Mathematical Physics may be found in [20, 13]. In addition symmetry analysis for time fractional partial differential equations can be found in [8]. Lie symmetry analysis for the Kudryashov-Sinelshikov equation may be found in [23] while Lie symmetry analysis for the Burgers' equation may be found in [11, 12]. Studies on the Korteweg-de Vries equation using Lie symmetry analysis are seen in [10, 22]. Interests in studying symmetries is so large that in [19] the definition of an admitted Lie group is developed for Stochastic differential equations.

We now state the definition of a Lie group which we will be using. We will also give some examples of Lie group to illustrate the definition.

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