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Symmetry Analysis and Conservation Laws of a Generalization of the Kelvin-Voigt Viscoelasticity Equation

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Abstract: In this work, we study a generalization of the well-known Kelvin-Voigt viscoelasticity equation describing the mechanical behavior of viscoelasticity. We perform a Lie symmetry analysis. Hence, we obtain a classification of the Lie point symmetries of the equation. Afterward, it is important to classify invariant solutions according to the classification of the associated symmetry generators, so we find the set of exactly one generator from each class. This problem of obtaining an optimal system of subgroups is equivalent to that of obtaining an optimal system of subalgebras. For this classification problem, we use the adjoint representation. Then, we transform the partial differential equation into an ordinary differential equation, by using the symmetry reductions of each element of the optimal system. Furthermore, we determine the conservation laws of this equation, by applying the multiplier method, developed by Anco and Bluman. Finally, a complete classification of multipliers is given, followed by a classification of the conserved density and spatial flux of the conserved current.

Keywords: viscoelasticity; Kelvin-Voigt equation; Lie symmetries; optimal system; group-invariant solutions; conservation laws; multiplier method

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