Review of: "New Approximate Symmetry Theorems and Comparisons With Exact Symmetries"

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Potential competing interests: No potential competing interests to declare.

Review Report: New Approximate Symmetry Theorems and Comparisons with Exact Symmetries

The manuscript by Mehmet Pakdemirli introduces three novel approaches to approximate symmetry theories and compares these with existing methods and exact symmetries. By applying these theories to nonlinear ordinary differential equations (ODEs), the author successfully demonstrates their potential in deriving both approximate and, in some cases, exact solutions. This contribution is timely and relevant, as the search for effective methods to solve nonlinear ODEs remains a significant challenge in mathematical physics and applied mathematics.

Areas for Improvement

1. It could benefit from a clearer explanation of the assumptions underlying each new method. Specifically, elaborating on the choice of perturbation parameter and its impact on the symmetry generator could enhance the reader's understanding.

2. The manuscript mentions alternative methods like exterior calculus and Noetherian symmetries but does not delve into a detailed comparison with these approaches. A more detailed analysis could provide a more comprehensive overview of the landscape of symmetry theories.

3. A discussion on how these definitions interact with the Lie Algebra and the implications for solving differential equations would be beneficial.

4. While the manuscript does a commendable job of applying the theories to general nonlinear ODEs, incorporating specific, detailed case studies could illustrate the practical applications more vividly. These case studies could highlight the nuances of each method and provide a clearer picture of their utility in real-world scenarios.

5. Any discussion on the computational complexity of the new methods compared to existing approaches would be valuable. This aspect is particularly important for potential users who need to consider computational resources and efficiency.