

Abstract

# Lie and Conditional Symmetry of Nonlinear Boundary Value Problems: Definitions, Algorithms and Applications <sup>†</sup>

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Nowadays, Lie and conditional symmetries are widely applied to study nonlinear partial differential equations (PDEs) (including multidimensional PDEs), notably for their reductions to ordinary differential equations and construction of exact solutions. There is a huge number of papers and many excellent books devoted to such applications. Over recent decades, other symmetry methods, which are based on the classical Lie method, were also derived and applied for solving nonlinear PDEs. On the other hand, one may note that the symmetry-based methods were not widely used for solving boundary-value problems (BVPs).

In our recent papers [1,2], a new definition of Lie and conditional invariance of BVPs with a wide range of boundary conditions (including those at infinity and moving surfaces) was formulated and an algorithm for finding such symmetries for the given class of BVPs was determined. The definition and algorithm were applied to some classes of nonlinear (including multidimensional) BVPs arising in physical and biological applications in order to show their efficiency (see [1–3] and the references cited therein). As a result, Lie and conditional symmetries for several BVPs were completely described, reductions to BVPs of lower dimensionality were constructed and examples of exact solutions with physical/biological meaning were found. This talk is based on the results obtained in [3] and some unpublished results.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Cherniha, R.; Kovalenko, S. Lie symmetries of nonlinear boundary value problems. *Commun. Nonlinear Sci. Numer. Simul.* **2012**, *17*, 71–84.
2. Cherniha, R.; King, J.R. Lie and Conditional Symmetries of a Class of Nonlinear (1 + 2)-dimensional Boundary Value Problems. *Symmetry* **2015**, *9*, 1410–1435.
3. Cherniha, R.; Davydovych, V.; King, J.R. Lie symmetries of nonlinear parabolic-elliptic systems and their application to a tumour growth model. *arXiv* **2017**, arXiv:1704.07696.



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