a place of mind
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Chair of the Habilitation Committee

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Czech Republic

May 2, 2019

Re: Roman Popovych, D.Sc.

Based on his Habilitation Thesis, I strongly recommend that Roman Popovych, visiting fellow at the Mathematics Institute of the Silesian University in Opava, Czech Republic, be awarded the degree of "Docent."

Roman is one of the world's leading experts on symmetry properties of differential equations. This is exhibited by his work in the five presented papers and his summary introduction. He is hard-working, writes many papers and has had many excellent students.

Let me summarize his contributions from the exhibited papers:

In [T1], Kunzinger and Popovych introduce the terminology of singular reduction operators to study in more detail the notion of nonclassical symmetries with exhaustive investigations of evolution and nonlinear wave equations. He exhibits comprehensively the differences in analyses required when seeking nonclassical symmetries for evolution and nonlinear wave equations.

In [T2], Popovych exhaustively studies the existence and non-existence of nonclassical symmetry reductions for second order linear parabolic equations with one space variable, (i.e, the 1 + 1 case). This paper mentions "no-go" results. But within this paper and in [T1], it is not clear to the reader what "no-go" means since this term introduced by Roman Poovych and used in many of his papers in connection with nonclassical symmetry reductions does not appear to be explicitly defined! Papers [T1] and [T2] are closely related.

In [T3]. Kunzinger and Popovych consider nonclassical symmetry reductions based on extensions of generalized (also called Lie-Bäcklund or higher-order) symmetry reductions for evolution equations. [In the previous two papers, nonclassical symmetry reductions are based on extensions of Lie point symmetry reductions.] In this paper, Popovych's notion of "a no-go theorem" is carefully laid out in Section 7. In this paper, the authors carefully lay out the difficulties in finding nonclassical generalized symmetries in contrast to finding nonclassical

symmetries based on extensions of point symmetries. They also carefully give a more comprehensive theoretical basis for nonclassical generalized symmetries than previous authors. The authors also discuss the problem of incompleteness in calculations of nonclassical generalized symmetries for evolution equations.

In [T4], Kunzinger and Popovych significantly extend results of Bluman, Cheviakov and Ivanova on the forms of characteristics that can produce potential conservation laws (i.e., conservation laws that are not local conservation laws). This work is important for the construction of distinct nonlocally related systems for a given PDE system from conservation laws.

In [T5], Popovych and Bihlo formulate general algorithms for finding local parametrization schemes with prescribed invariance characteristics. This work is connected with the inverse problem of finding PDEs that admit particular point symmetries. This work is important in connection with the problem of finding structure-preserving closure models (parametrization schemes) for the subgrid-scale that arises when discretizing a nonlinear PDE system due to the limited resolution when integrating a numerical model.

As exhibited in these papers, Roman Popovych's work is meticulous. Many of his papers are hard to read, especially by non-experts, due to the excruciating detail. Much of his work can be characterized as giving a very detailed theoretical foundation to less polished ideas introduced by others. None of his work is trivial, unlike most work in the field of symmetries and differential equations!

George Bluman,

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