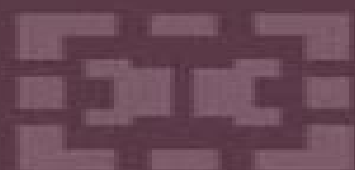


Mathematics and Its Applications

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I.S. Krasil'shchik  
and P.H.M. Kersten

Symmetries and Recursion  
Operators for Classical  
and Supersymmetric  
Differential Equations



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# Symmetries And Recursion Operators For Classical And Supersymmetric Differential Equations

**Rose Arny**



## **Symmetries And Recursion Operators For Classical And Supersymmetric Differential Equations:**

### **Symmetries and Recursion Operators for Classical and Supersymmetric Differential Equations I.S.**

Krasil'shchik, P.H. Kersten, 2013-01-18 To our wives Masha and Marian Interest in the so called completely integrable systems with infinite number of degrees of freedom was aroused immediately after publication of the famous series of papers by Gardner Greene Kruskal Miura and Zabusky 75 77 96 18 66 19J see also 76 on striking properties of the Korteweg de Vries KdV equation It soon became clear that systems of such a kind possess a number of characteristic properties such as infinite series of symmetries and or conservation laws inverse scattering problem formulation L A pair representation existence of prolongation structures etc And though no satisfactory definition of complete integrability was yet invented a need of testing a particular system for these properties appeared Probably one of the most efficient tests of this kind was first proposed by Lenard 19 who constructed a recursion operator for symmetries of the KdV equation It was a strange operator in a sense being formally integro differential its action on the first classical symmetry  $x$  translation was well defined and produced the entire series of higher KdV equations but applied to the scaling symmetry it gave expressions containing terms of the type  $\int u dx$  which had no adequate interpretation in the framework of the existing theories It is not surprising that P Olver wrote The deduction of the form of the recursion operator if it exists requires a certain amount of inspired guesswork 80 p

*Symmetries and Recursion Operators for Classical and Supersymmetric Differential Equations* Iosif Semenovitch Krasil'shchik, P.H. Kersten, 2000-05-31 This book is a detailed exposition of algebraic and geometrical aspects related to the theory of symmetries and recursion operators for nonlinear partial differential equations PDE both in classical and in super or graded versions It contains an original theory of Frlicher Nijenhuis brackets which is the basis for a special cohomological theory naturally related to the equation structure This theory gives rise to infinitesimal deformations of PDE recursion operators being a particular case of such deformations Efficient computational formulas for constructing recursion operators are deduced and in combination with the theory of coverings lead to practical algorithms of computations Using these techniques previously unknown recursion operators together with the corresponding infinite series of symmetries are constructed In particular complete integrability of some superequations of mathematical physics Korteweg de Vries nonlinear Schrödinger equations etc is proved Audience The book will be of interest to mathematicians and physicists specializing in geometry of differential equations integrable systems and related topics

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**The Symbolic Computation of Integrability Structures for Partial Differential Equations** Joseph Krasil'shchik, Alexander Verbovetsky, Raffaele Vitolo, 2018-04-03 This is the first book devoted to the task of computing integrability structures by computer The symbolic computation of integrability operator is a computationally hard problem and the book covers a huge number of situations through tutorials The mathematical part of the book is a new approach to integrability structures that allows to treat all of them in a unified way The software is an official package of Reduce Reduce is free software so everybody can download it and make experiments using the programs available at our website

*Cohomological Analysis of Partial Differential Equations and Secondary Calculus* A. M. Vinogradov, 2001-10-16 This book is dedicated to fundamentals of a new theory which is an analog of affine algebraic geometry for nonlinear partial differential equations This theory grew up from the classical geometry of PDE s originated by S Lie and his followers by incorporating some nonclassical ideas from the theory of integrable systems the formal theory of PDE s in its modern cohomological form given by D Spencer and H Goldschmidt and differential calculus over commutative algebras Primary Calculus The main result of this synthesis is Secondary Calculus on diffeities new geometrical objects which are analogs of algebraic varieties in the context of nonlinear PDE s Secondary Calculus surprisingly reveals a deep cohomological nature of the general theory of PDE s and indicates new directions of its further progress Recent developments in quantum field theory showed Secondary Calculus to be its natural language promising a nonperturbative formulation of the theory In addition to PDE s themselves the author describes existing and potential applications of Secondary Calculus ranging from algebraic geometry to field theory classical and quantum including areas such as characteristic classes differential invariants theory of geometric structures variational calculus control theory etc This book focused mainly on theoretical aspects forms a natural dipole with Symmetries and Conservation Laws for Differential Equations of Mathematical Physics Volume 182 in this same series Translations of Mathematical Monographs and shows the theory in action

Integrable Hierarchies and Modern Physical Theories Henrik Aratyn, Alexander S. Sorin, 2012-12-06 Proceedings of the NATO Advanced Research Workshop Chicago USA July 22 26 2000

*Nonlinear Systems and Their Remarkable Mathematical Structures* Norbert Euler, Da-jun Zhang, 2021-09-06 The third volume in this

sequence of books consists of a collection of contributions that aims to describe the recent progress in nonlinear differential equations and nonlinear dynamical systems both continuous and discrete Nonlinear Systems and Their Remarkable Mathematical Structures Volume 3 Contributions from China just like the first two volumes consists of contributions by world leading experts in the subject of nonlinear systems but in this instance only featuring contributions by leading Chinese scientists who also work in China in some cases in collaboration with western scientists Features Clearly illustrate the mathematical theories of nonlinear systems and its progress to both the non expert and active researchers in this area Suitable for graduate students in Mathematics Applied Mathematics and some of the Engineering Sciences Written in a careful pedagogical manner by those experts who have been involved in the research themselves and each contribution is reasonably self contained

### **Algebraic Structures In Integrability: Foreword By Victor Kac**

Vladimir V Sokolov, 2020-06-05 Relationships of the theory of integrable systems with various branches of mathematics are extremely deep and diverse On the other hand the most fundamental exactly integrable systems often have applications in theoretical physics Therefore many mathematicians and physicists are interested in integrable models The book is intelligible to graduate and PhD students and can serve as an introduction to separate sections of the theory of classical integrable systems for scientists with algebraic inclinations For the young the book can serve as a starting point in the study of various aspects of integrability while professional algebraists will be able to use some examples of algebraic structures which appear in the theory of integrable systems for wide ranging generalizations The statements are formulated in the simplest possible form However some ways of generalization are indicated In the proofs only essential points are mentioned while for technical details references are provided The focus is on carefully selected examples In addition the book proposes many unsolved problems of various levels of complexity A deeper understanding of every chapter of the book may require the study of more rigorous and specialized literature

### The Interplay between Differential Geometry and Differential Equations

Valentin Vasil'evich Lychagin, 1995 谷口 隆夫, 2000 *Lie Groups, Geometric Structures and Differential Equations* Tohru Morimoto, Hajime Satō, Keizo Yamaguchi, 2002 The blending of algebra geometry and differential equations has a long and distinguished history dating back to the work of Sophus Lie and Elie Cartan Overlooking the depth of their influence over the past 100 years presents a formidable challenge A conference was held on the centennial of Lie's death to reflect upon and celebrate his pursuits later developments and what the future may hold This volume showcases the contents atmosphere and results of that conference Of particular importance are two survey articles Morimoto develops a synthetic study of Lie groups geometric structures and differential equations from a unified viewpoint of nilpotent geometry Yamaguchi and Yatsui discuss the geometry of higher order differential equations of finite type Contributed research articles cover a wide range of disciplines from geometry of differential equations CR geometry and differential geometry to topics in mathematical physics This volume is intended for graduate students studying differential geometry and analysis and advanced graduate students

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