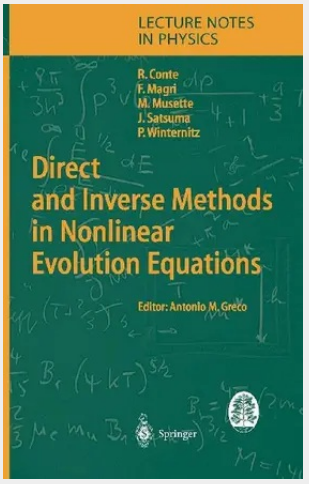
Conte / Greco / Magri

Direct and Inverse Methods in Nonlinear Evolution Equations

Lectures Given at the C.I.M.E. Summer School Held in Cetraro, Italy, September 5-12, 1999



Many physical phenomena are described by nonlinear evolution equation. Those that are integrable provide various mathematical methods, presented by experts in this tutorial book, to find special analytic solutions to both integrable and partially integrable equations. The direct method to build solutions includes the analysis of singularities à la Painlevé, Lie symmetries leaving the equation invariant, extension of the Hirota method, construction of the nonlinear superposition formula. The main inverse method described here relies on the bi-hamiltonian structure of integrable equations. The book also presents some extension to equations with discrete independent and dependent variables.
The different chapters face from different points of view the theory of exact solutions and of the complete integrability of nonlinear evolution equations. Several examples and applications to concrete problems allow the reader to experience directly the power of the different machineries involved.

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