Geometric Numerical Integration: Structure Preserving Algorithms for Ordinary Differential Equations

Ernst Hairer, Christian Lubich, Gerhard Wanner

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Numerical methods that preserve properties of Hamiltonian systems, reversible systems, differential equations on manifolds and problems with highly oscillatory solutions are the subject of this book. A complete self-contained theory of symplectic and symmetric methods, which include Runge-Kutta, composition, splitting, multistep and various specially designed integrators, is presented and their construction and practical merits are discussed. The long-time behaviour of the numerical solutions is studied using a backward error analysis (modified equations) combined with KAM theory. The book is illustrated by many figures, it treats applications from physics and astronomy and contains many numerical experiments and comparisons of different approaches.

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