Line Integral Methods for Conservative Problems (Monographs and Research Notes in Mathematics)

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Line Integral Methods for Conservative Problems explains the numerical solution of differential equations within the framework of geometric integration, a branch of numerical analysis that devises numerical methods able to reproduce (in the discrete solution) relevant geometric properties of the continuous vector field. The book focuses on a large set of differential systems named conservative problems, particularly Hamiltonian systems.

Assuming only basic knowledge of numerical quadrature and Runge–Kutta methods, this self-contained book begins with an introduction to the line integral methods. It describes numerous Hamiltonian problems encountered in a variety of applications and presents theoretical results concerning the main instance of line integral methods: the energy-conserving Runge–Kutta methods, also known as Hamiltonian boundary value methods (HBVMs). The authors go on to address the implementation of HBVMs in order to recover in the numerical solution what was expected from the theory. The book also covers the application of HBVMs to handle the numerical solution of Hamiltonian partial differential equations (PDEs) and explores extensions of the energy-conserving methods.

With many examples of applications, this book provides an accessible guide to the subject yet gives you enough details to allow concrete use of the methods. MATLAB codes for implementing the methods are available online.

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