数学与系统科学研究院

计算数学所定期学术报告

报告人：Prof. Jesús María Sanz-Serna

（ *Departamento de Matemáticas, Universidad Carlos III de Madrid* ）

报告题目：

Symplectic Runge-Kutta methods for nonsymplectic problems

邀请人： 孙雅娟 研究员

报告时间：2016 年 9 月 22 日（周四）

下午 16:00-17:00

报告地点： 科技综合楼三层

311 报告厅

Abstract:

The study of the sensitivity of the solution of a system of differential equations with respect to changes in the initial conditions leads to the introduction of an adjoint system, whose discretization is related to reverse accumulation in automatic differentiation. Similar adjoint systems arise in optimal control and other areas, including classical mechanics. Adjoint systems are introduced in such a way that they exactly preserve a relevant quadratic invariant (more precisely, an inner product). Symplectic Runge–Kutta and partitioned Runge–Kutta methods are defined through the exact conservation of a differential geometric structure, but may be characterized by the fact that they preserve exactly quadratic invariants of the system being integrated. Therefore, the symplecticness (or lack of symplecticness) of a Runge–Kutta or partitioned Runge–Kutta integrator should be relevant to understanding its performance when applied to the computation of sensitivities, to optimal control problems, and in other applications requiring the use of adjoint systems. This talk examines the links between symplectic integration and those applications. In particular, we show how some common procedures, such as the direct method in optimal control theory and the computation of sensitivities via reverse accumulation, imply, probably unbeknownst to the user, "hidden" integrations with symplectic partitioned Runge–Kutta schemes.

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