UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO DI MATEMATICA

INdAM Unità di Ricerca Università degli Studi di Bari Aldo Moro

DIPARTIMENTO DI INFORMATICA

PhD Programme in Computer Science and Mathematics

SEMINAR ANNOUNCEMENT

Prof. Gustaf Söderlind

Lund University, Sweden

Thursday – November, 7
Time: 3:10 p.m.
Room: Aula VI, Mathematics Department

The Mathematics of Stiffness. Evolution of a Concept.

The notion of stiffness was introduced in 1952 by Curtiss and Hirschfelder. It was recognized that some well-posed initial value problems required dedicated implicit methods. For many years, attempts were made to characterize stiffness. A significant issue was that mathematical problem properties were mixed with operational criteria describing how a given method interacted with the problem, e.g. in terms of discretization errors and the accuracy requirement. Here we introduce a new criterion based exclusively on properties of the differential equation's vector field. Thus we construct a functional on the vector field, which defines a local reference time scale. The latter is compared to the range of integration, or to the desired time step. Stiffness is characterized by a large ratio of the range of integration to the local reference time scale. This characterization can be computed along the solution trajectory, quantifying the (possibly changing) character of the solution. We show that the mathematically necessary condition for stiffness in principle only depends on the divergence of the vector field of the ODE, and on the range of integration. We will explain and illustrate the new theory with numerous examples of how stiffness can be identified also in strongly nonlinear systems. Time permitting, we will also discuss cheap stiffness estimators for implementation in standard solvers.

Gustaf Söderlind is professor emeritus at Mathematics, Faculty of Sciences, Numerical Analysis group, and professor at eSSENCE: The e-Science Collaboration. He is visiting professor of the Department of Computer Science from 6 of October to 6 of December. His research activity is related to numerical analysis of differential equations, covering all aspects from theoretical analysis to applied problems and software construction. Special research topics include: adaptivity for ODEs, using control theory and digital signal processing; adaptivity in geometric integration, using splitting methods; daptive grid generation in 2-point BVPs; stability analysis of nonlinear discretizations; discretization error analysis; dynamics of iterative methods; computational problems in physiology, especially cardiomodelling.