Applied and Numerical Analysis Seminar

Numerical methods for stiff ODEs. Application to the Finite Element Method

Elisabete Alberdi Celaya
ACMAC and University of the Basque Country UPV/EHU

Abstract

The second order ODE system obtained after semidiscretizing a wave-type PDE with the Finite Element Method (FEM), shows strong numerical stiffness. Although it can be integrated using Matlab odesolvers, the function *ode15s* offered by Matlab for solving stiff ODE systems is not very efficient as its resolution requires the use of numerical methods with good stability properties and controlled numerical dissipation in the high-frequency range. This has lead us to study the Backward Differentiation Formulae (BDF) in which this ode solver is based on and to work in two directions:

- The study and application of methods which use superfuture points and which result unconditionally stable up to order 4.
- The review of direct methods for second order ODEs used in computational mechanics, in particular the Newmark parametric family in which the second order accurate and unconditionally stable HHT-α is based. This method offers high frequency dissipation for some values of the parameter α. In this sense, we have constructed a modification of the 2-order BDF method (the BDF2 method), which we have called BDF-α. This new method is second-order accurate and with a smaller local truncation error than the BDF2, it is unconditionally stable for some values of α and it permits a parametric control of the numerical dissipation.

Taking into account the similarity between the governing PDEs in different applications, common blocks for Finite Element approximation have been identified, and an Object Oriented Programming (OOP) methodology for linear and non linear, stationary and dynamic problems has been developed. Advantages of this approach are commented and some results are shown as examples of this methodology.

Monday, 09 September 2013
11.00, ACMAC Seminar Room