"hp-techniques in mechanics" organized by Alexander Düster

Miniworkshop

Miniworkshop "High Order Finite Elements" organized by Joachim Schöberl,
October 19, 2005, 10:15 - 16:00, Room: HF 136

Lectures on "High order FEM"

1. Introduction
2. Motivation
   The finite element method-some basic principles
   A simple one-dimensional example (with smooth/non-smooth solution)
3. Hierarchic shape functions
   Hierarchic shape functions for one-dimensional problems
   Hierarchic shape functions for quadrilaterals
   Hierarchic shape functions for hexahedrals
4. Mapping functions
   Mapping concepts
   The blending function method
   Exact representation of geometry vs. low order polynomial approximation
   Quasi-regional mapping
   Representation of rigid body modes
   Distorted elements
5. Computation of element matrices, assembly, contraint enforcement and solution
   Computation of element matrices
   Assembly and contraint enforcement
   Solution (static condensation)
6. Convergence characteristics
   Classification
   A priori estimates
   The choice of finite element spaces
   Error estimation in energy norm (by extrapolation)
   A one-dimensional example
   A two-dimensional example
7. Mechanical models and finite elements for thin-walled structures
   Three-dimensional curved thin-walled structures
   The Reissner-Mindlin plate theory
   The locking phenomenon
8. Computation of thin-walled structures
   Plate with columns
   Scordelis-Lo shell
   A hemispherical shell with stiffener

If time allows, additional applications like hyperelasticity and elastoplasticity will be addressed.

Literature

[1] Barna Szabo, Ivo Babuska.
Finite Element Analysis,
John Wiley & Sons, 1991.

[2] Barna Szabo, Alexander Düster, Ernst Rank.
The p-version of the Finite Element Method,
Encyclopedia of Computational Mechanics,
John Wiley & Sons, 2004.

[3] Alexander Düster.
High order FEM,
Lecture Notes (will be available),
TU München, 2005.

The lecture was held for students of the International Master Program in Computational Mechancis as well as for students of Civil Engineering at the Technische Universität München for the first time during summer term 2005. Lecture notes will be available. Please visit also the corresponding homepage for additional information and material (slides, maple worksheets and C++ code).