Seminar on

The Finite Element Method and the Analysis of Systems with Uncertain Properties

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&
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Engineering analysis, in some way or another, serves the support of decision making. For this reason it is necessary to develop engineering models which facilitate the assessment of the characteristics of the considered systems which are of significance for the decision making. This concerns not least the analysis of the performance of engineering systems such as structures and machines but also concerns the stability of slopes, stiffness and strength properties of soils and e.g. contamination of ground water.
The finite element method has proven over the last decades to comprise a very strong analysis tool for the representation and assessment and a large variety of engineering problems which may be modelled through the solution of differential equations. However, as many of the properties or parameters entering the equations systems are subject to various types of uncertainty it is of importance to assess the significance of these uncertainties for the assessed performance, i.e. the solutions obtained through the application of the finite element method. For the purpose of decision making the real objective is to achieve the joint probability distribution of the response characteristics of interest for the decision problems.

The present study group seminar is concerned about the application of the finite element method in engineering problems as well as the treatment of uncertainties within this analysis framework. The seminar will start out with a relatively fast revisit of the theory of finite element methods considering linear systems and thereafter first introduce the basics of probabilistic modelling and assessment in engineering and finally introduce the theory of stochastic finite element methods.
Throughout the seminar one or more exercises will be conducted and developed from meeting to meeting such that at the end of the seminar the example will contain all aspects of the treated material.

Who should attend?

Researchers, Ph. D. students, post-docs and graduate students interested in the subject of finite element methods and in the problem how to treat uncertainties within this analysis framework.

Mode

The seminar will be conducted as a study group under the responsibility of Prof. Faber and Dr. Mojsilović. All participants will in turn be responsible for presenting a part of the material and for developing the examples.

Literature

Bathe, K.J., Finite Element Procedures, Prentice Hall, 1996.

Halder, A. and Mahadevan, S. Reliability Assessment Using Stochastic Finite Element Analysis, Wiley, 2000.

When and where?

Wednesdays, 16:45 – 18:00, ETH Hönggerberg, HIL E5.

Agenda

W	Date	Speaker	Topic
1	01.11.06 Lecture moved form 25.10.06!	Prof. Michael Faber	Introduction and description of course material; Introduction to the use of finite elements - Physical problem, mathematical modelling and finite element solutions - Finite elements as a tool for computer supported design and assessment - Basic mathematical tools (vectors, tensors and matrix calculus)
2	01.11.06	Andrew Zurkinden	Basic concepts of engineering analysis - Solution of mathematical models of discrete and continuous systems
3	08.11.06	Benedikt Thielemann	Formulation of the method of finite elements - Formulation of the displacement based finite element method and (general) convergence of results
4	15.11.06	Eva Sabiote	Formulation and calculation of isoparametric finite element matrixes - Truss element - Continuum elements – triangular elements
5	22.11.06	Mario Foresti	Formulation and calculation of isoparametric finite element matrixes - Continuum elements – square elements - (Detailed) Convergence considerations
6	29.11.06	Cornelius Gauer	Formulation and calculation of isoparametric finite element matrixes - Element matrixes in global coordinates - Displacement /pressure related elements for incompressible media
7	06.12.06	Jianjun Qin	Formulation and calculation of isoparametric finite element matrixes - Formulation of structural elements (beam elements and axial-symmetrical shell elements)
8	13.12.06	Andreas Mena	Formulation and calculation of isoparametric finite element matrixes - Formulation of structural elements (plate and general shell elements)
9	20.12.06	Gilles Richner	Formulation and calculation of isoparametric finite element matrixes - Numerical integration and implementation of a finite element computer code
10	10.01.07	Maria Reif	Solution of static finite element problems - The LDL- solution
11	17.01.07	Prof. M. Faber	Introduction to reliability analysis
12	24.01.07	Falk Wittel	Implicit performance functions and introduction to stochastic FEM (SFEM)
13	31.01.07	N. Mojsilovic	SFEM for linear static problems
14	07.02.07	Vasiliki Malioka	SFEM for spatial variability problems