



Oreste S. Bursi

Oreste S. Bursi graduated in Mechanical Engineering at the University of Padua in 1984, and

achieved his PhD. in Mechanical Engineering at the University of Bristol. He is Full Professor of Structural Dynamics and Control at the University of Trento. The research activity is mainly devoted to the pseudo-dynamic test method, non-linear dynamics, control and structural identification.

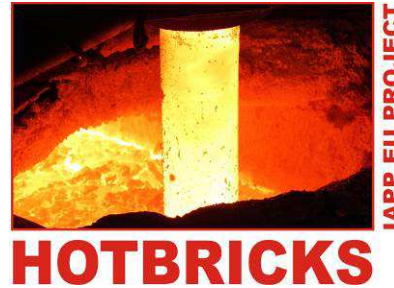
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Nicola Tondini

Nicola Tondini received his PhD in Structural Engineering at the University of Trento in 2009. He is currently Assistant Professor at the Department of Civil,

Environmental and Mechanical Engineering at the University of Trento. His research interests mainly involve the behaviour of structures subjected to fire, both experimentally and numerically, with emphasis on the development of advanced computations methods.



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Doctoral School in Civil,
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Nonlinear analysis for Dynamic and Thermo- mechanical problems

Course offered by **Oreste S. Bursi**,
University of Trento and **Nicola Tondini**,
University of Trento.
November 27-28, 2014.
Department of Civil, Env. and
Mechanical Eng. University of Trento.

Course objective

The scope of the course is to provide knowledge of nonlinear analysis of dynamic as well as of thermo-mechanical systems solved by means of the Finite Element Method. With regard to dynamic problems, the main properties of numerical integrators for the determination of the transient dynamic response of monolithic structural systems, as well as of heterogeneous subsystems, decomposed by computational or physical considerations is presented. Thus, ad hoc computational methods are presented in a common framework along with a few applications. As regards thermo-mechanical problems, basic theoretical formulation of FE thermoelasticity will be highlighted. FE thermo-mechanical examples including plasticity models in the context of structural engineering applications will be presented. Example of a weak coupling between a Computational Fluid-Dynamics software and an FE software will be also provided.

Who should attend

Graduate students in engineering interested in nonlinear structural dynamics and in thermo-mechanical problems, and researchers, in modern mechanical/structural engineering.

Course outline

Form of equations of Structural Dynamics and Solution Techniques. Euler-Lagrange form. Hamilton form. Corrections and compensation techniques for non-linear problems.

Classification, analysis and properties of time integration algorithms. Classification of time integration algorithms. Analysis of time integration algorithms. Accuracy, Absolute Stability and the phenomenon of stiffness. Dissipation and dispersion. Error propagation.

Monolithic and partitioned time integration schemes for dynamic systems operating in real time. L-stable methods for monolithic systems. L-stable methods for heterogeneous coupled systems. Partitioned methods based on the FETI approach. The PM-alpha method. Representative model problems.

Fundamentals of FE thermo-mechanical problems applied to structural engineering. Basic concepts of the FE method. Formulation of a FE thermoelastic problem. Example of the thermo-mechanical FE code SAFIR that implements plasticity models. Case studies of structures subjected to fire.

Implementation of an integrated modelling strategy between a CFD software and an FE software. General formulation of a full CFD-FE coupling approach. Assumptions and simplifications of a weak coupling approach. Examples of weak coupling approach applied to structures subjected to fire.

Suggested readings.

- Bursi O.S., (2008), *Computational Techniques for Simulation of Monolithic and Heterogeneous Structural Dynamic Systems in Modern Testing Techniques for Structural Systems -Dynamics and Control*, O.S. Bursi and D.J. Wagg ed., CISM-Springer Wien NewYork.
- Hughes, T.J.R., (2000) *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis* -Dover Civil and Mechanical Engineering-
- R.B. Hetnarski; M. Reza Eslami *Thermal Stresses – Advanced Theory and Applications*, springer, 2008.
- O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, *The Finite Element Method – Its Basis & Fundamentals*, 6th Edition, Elsevier, 2008.
- Tondini N., Vassart O. and Franssen J.-M. (2012) *Development of an interface between CFD and FE software. Proceedings of the 7th Conference on Structures in Fire, Zurich, Switzerland, 6-8 June.*
- Franssen J.-M. (2005) *SAFIR. A Thermal/Structural Program Modelling Structures under Fire, , Engineering Journal, A.I.S.C., Vol 42, No. 3, 143-158*

Course schedule

Thursday, November 27, 2014

14.00-18.30

Room R1

Friday, November 28, 2014

9.00-13.30

Room R1

Information

The course is free of charge.

For further information, contact
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