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Tools and Techniques

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Contents

Preface

This volume comprises the Invited Lectures presented at The Eleventh International Conference on Civil, Structural and Environmental Engineering Computing (Civil-Comp 2007) and The Ninth International Conference on the Application of Artificial Intelligence to Civil, Structural and Environmental Engineering (AICivil-Comp 2007) held at St. Julians, Malta from 18 to 21 September 2007. The Civil-Comp conferences are part of the series that commenced in 1983. These lectures provide a snapshot of key current research areas.

Chapter 1, an Invited Keynote Lecture by Professor Adeli and Dr Jiang, demonstrates how smart structures may be developed using a combination of innovative computer hardware and advanced computational technology. These computational technologies include neural networks, genetic algorithms and data mining techniques, all of which have been of growing interest to our community since Professor Adeli's first Civil-Comp conference paper in 1985. Chapter 1 shows how smart techniques may be developed for reinforced concrete frames using damage detection and evaluation methods with nonlinear control techniques.

In Chapter 2, an Invited Keynote Lecture by Professor Gero, describes the principles of situated design computing which expands computing from the encoding of objective knowledge to include knowledge acquisition while the design programs are used. This chapter contributes to a long standing objective of the Civil-Comp conferences to encourage the modelling of the design process in the widest sense.

In Chapter 3, the first of the Invited Special Lectures, Drs Eyheramendy and Oudin-Dardin discuss how object-oriented techniques may be used in the development of strongly coupled multiphysics. These programming techniques are shown to provide the robust development of computer codes for the solution of highly complex problems.

In Chapter 4, Dr Dolenc describes recent trends in engineering collaboration enabled by the grid, the world wide web, data standards and models. The theme of these enabling technologies which provide for collaboration is continued in Chapter 5, by Professor Chassiakos. In this chapter the motivation is construction management and the technologies include virtual reality, document and web-based project management, mobile computing, application service providers and wireless communication.

Chapter 6, by Professor Saka, reviews the use of evolutionary methods for the design of steel structures, including: genetic algorithms, evolutionary strategies, immune system algorithms, simulated annealing, particle swarm optimization and the harmony search method.

In Chapter 7, Professor Miles and his colleagues discuss how evolutionary algorithms can be used to find "good solutions" to topological design problems. Their paper addresses a problem that has vexed researchers for over thirty years and sadly concludes that current topological reasoning processes are still limited.

Chapters 8 and 9 continue the structural engineering design theme. In Chapter 8, Professor Marti, describes techniques for structural plastic analysis and optimal plastic design under uncertainty. Professor Damkilde reviews ultimate limit state analysis and design based on a finite element approach.

Chapters 10, 11 and 12 consider masonry, cable and scaffold structures respectively. First in Chapter 10, Professors Milani and Lourenço review the application of homogenisation limit analysis to masonry structures. They consider the collapse failure of masonry structures where the mortar properties are randomized. In Chapter 11, Professor Gattulli provides an extensive review of passive, semi-active and active control strategies for cable dynamics. Dr Beal reviews recent research into scaffold structures in Chapter 12. This chapter also includes a review of research into modelling, design loading and falsework collapses. Chapter 13, by Professor Leung, describes the determination of the exact dynamic stiffness for the calculation of frame buckling under biaxial moments and torque.

Chapters 14 and 15 both consider the modelling of the behaviour of concrete. In Chapter 14, Professors Salomoni, Majorana and Khoury develop a stress-strain relationship for use in finite element models of concrete. Their chemo-thermo-hydro-mechanical model may be used to model concrete at high temperatures. In Chapter 15, Dr Šmilauer and Professor Bittnar describe the modelling of the microstructural evolution of concrete, including the modelling of the heat of hydration, elastic and viscoeleastic properties and the autogeneous shrinkage of cement paste.

In Chapter 16, Professor Aref and colleagues describe the analysis and optimal design of multi-layered structures subject to impulse loading. Professor de Barros presents an extensive review of of the seismic analysis and design of anchored tanks in Chapter 17. This chapter includes a comparision of seismic design codes for bottom supported circular tanks. Finally, in Chapter 18, Professor Puppala and colleagues discuss the analysis of cone penetration tests using a range of theories from the literature.

I am grateful to the authors and co-authors of the invited lectures included in this volume. Their contribution both to the Civil-Comp conferences and this book is greatly appreciated.

Other papers presented at the conferences in 2007 are published as follows:

- *The Contributed Papers from Civil-Comp 2007 are published in:*
  Proceedings of the Eleventh International Conference on Civil, Structural and Environmental Engineering Computing, B.H.V. Topping (Editor), (Book of Abstracts and CD-ROM), Civil-Comp Press, Stirling, Scotland, 2007.
- *The Contributed Papers from AICivil-Comp 2007 are published in:*
  Proceedings of the Ninth International Conference on the Application of Artificial Intelligence to Civil, Structural and Environmental Engineering, B.H.V. Topping (Editor), (Book of Abstracts and CD-ROM), Civil-Comp Press, Stirling, Scotland, 2007.

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