Preface

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Biographical notes: Hedi Hassis was awarded his Ingénieur from Ecole Nationale d'Ingénieurs de Tunis (ENIT), in 1985, his PhD from Paris 6 University, on constitutive relations for geomaterials, in 1990, and his Docteur ès Sciences in Civil Engineering Structures from ENIT in 1999. He is a Professor at ENIT and Director of the Laboratoire de Génie Civil of ENIT. He is Chief Editor of the Tunisian new collection edition *Science and Technologie*, and one of Editors of the first and the second edition of *Advances in Geomaterials and Structures.* He has edited 14 books and authored or co-authored 21 international journal papers.

Félix Darve was awarded his Ingénieur from Ecole Centrale Paris in 1971, his PhD from Grenoble, on constitutive relations for geomaterials, in 1974, and his Docteur ès Sciences from Grenoble, on computational geomechanics, in 1978. He is Professor of Exceptional Rank at the Institut National Polytechnique de Grenoble, and President of ALERT Geomaterials (European research network of 20 universities). He is Chief Editor of the *Int. J. for Numerical and Analytical Methods in Geomechanics*, Chief Editor of the *European Journal of Environmental and Civil Engineering*, and a member of the Editorial Boards of *Computers and Geotechnics*, *Granular Matter*, and *Italian Geotechnical Journal*. He has edited or co-edited 14 books, and authored or co-authored 160 papers.

The strong development of phenomenological visco-elasto-plastic relations in the seventies and, in parallel, the enormous increase of the computational power, have given rise to a revolution in mechanical and civil engineering particularly by unifying elastic analyses in small strain and plastic failure in large deformations in a unique modelling framework. Today, phenomenological constitutive relations are more and more based on material microstructures, where the basic interaction laws between the elemental constituents can properly be defined and be expressed, often in a simple way, from a mechanical point of view.

The first Euro-Mediterranean Symposium on Advances in Geomaterials and Structures (AGS06) offered several examples of such micromechanical models developed in the line of that new avenue for formulating constitutive relations based on proper microscopic descriptions.

The finite element method is a tremendous engineering tool for modelling geomaterials and structures subjected to complex loading programmes. However, some limitations have been reached recently when the discontinuous aspects of matter have to be taken into account as for granular materials (e.g., sands), fractured media (e.g., rocks) or discontinuous failure modes (e.g., fragmentation). In these situations, discrete element methods, which are essentially particular applications of molecular dynamics methods to geomaterials, are a fascinating tool to describe these discontinuities and the induced global behaviour in a natural way. Several examples of such discrete computations in AGS06 illustrate the capacities of this numerical method.

Finally, the question of failure can also be revisited by considering it as a bifurcation problem. It appears in the experiments, and also in the elasto-plastic theory through the second-order work criterion, that failure defined by a limit state is linked to a burst of kinetic energy. This change of regime from static to dynamic conditions is a good indicator of a bifurcation state. Thus the existence of a bifurcation domain in the stress space (and not only of a plastic limit surface), where different failure modes can develop, represents probably a great breakthrough in this crucial domain from an engineering point of view.

The extended papers were presented at First Euro-Mediteranean Symposium on Advances in Geomaterial and Structures, Hammamet, May 2006.