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Modal Analysis and Testing

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Preface

The present book contains the revised texts of the main lectures presented at the NATO Advanced Study Institute (ASI) on Modal Analysis and Testing, held in Sesimbra, Portugal, 3-15 May 1998.

Modal Analysis is recognized nowadays as one of the most powerful tools, available to the engineer, for the dynamic analysis of structures. It can be said that the derivation of reliable models to represent the dynamics of complex structures is not possible without modal analysis. This field of study has suffered a strong development in the past few years, covering a wide range of interests and applications namely the identification and evaluation of vibration phenomena, the validation, correction and updating of analytical models, the assessment of structural integrity, etc. However, the subject, in its broad aspects, is currently considered too advanced and/or too specialised to be part of normal undergraduate or even post-graduate courses. On the other hand, the available literature is very reduced in number if one excludes papers published in specialised journals or presented at international scientific meetings.

Thus, it was thought that the organisation of an Advanced Study Institute (ASI) on the foundations, current state-of-the-art and recent developments of all essential techniques related to Modal Analysis and Testing would be an important and welcome contribution to increase research collaboration among different countries. In addition, such an ASI would provide a forum of interaction among leading scientists and young researchers from several countries and different schools of thought, assessing present directions and unifying trends for future research.

With the previous objectives in mind and taking advantage of their connections with the Modal Analysis research community, the ASI organizers managed to meet, in the U.S.A., some of the internationally recognized leading experts in the field and to agree upon their cooperation on the organisation of a comprehensive and well structured advanced course on Modal Analysis and Testing. The participation of these well known researchers insured the high scientific level of the course and its success. The venue was held in Sesimbra, Portugal, 20 miles from Lisbon.

The texts of the main lectures have been subjected to an editing and revision process, so that they could be "assembled" to form a coherent and comprehensive harmonized work. The result is the present book. After a first chapter on the fundamentals of Modal Analysis, the reader is introduced to signal processing and to the basic rules of exchange and analysis of dynamic information. The subject of the derivation of theoretical models for modal analysis is then addressed, followed by three chapters discussing the different

approaches to the derivation of models based on the identification of experimental data: time domain, frequency domain and pseudo-testing. The previous subjects lead to the discussion of updating of analytical models and to model quality assessment techniques in the chapters that follow.

Further on, the reader can find more specialised subjects such as damage detection and evaluation, structural modification and damping modelling. The normalisation of complex modes is also addressed.

Finally, other seldom covered subjects are included: active control of structures, acoustic modal analysis and neural networks for modal analysis are discussed followed by advanced optimisation methods for model updating, modal analysis for rotating machinery and nonlinearity in modal analysis.

We believe that this book may constitute a fundamental reference for many people in different domains of activity, as it covers not only the basics but also a complete and wide range of subjects that embrace nowadays the most important fields of interest of the modal analysis research community.

We wish to take this opportunity to thank all contributors and participants to the ASI. Special thanks go to Professors Samir Ibrahim, Michael Link and David Ewins for their efforts in the planning and organisation of the Institute. Finally, we are grateful to the NATO Office of Scientific Affairs and Dr. Veiga da Cunha, without whom the Institute and this book would not have been possible. Their support, together with the other sponsors listed in the book, is gratefully acknowledged.

March, 1999

Júlio M. Montalvão e Silva

Nuno M. M. Maia

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