Alexander K. Belyaev
Robin S. Langley
Editors

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IUTAM Symposium on the Vibration Analysis of Structures with Uncertainties

Proceedings of the IUTAM Symposium on the Vibration Analysis of Structures with Uncertainties held in St. Petersburg, Russia, July 5–9, 2009

Springer

IUTAM Symposium on the Vibration Analysis of Structures with Uncertainties

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Volume 27

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ISSN 1875-3507
ISBN 978-94-007-0288-2
DOI 10.1007/978-94-007-0289-9
Springer Dordrecht Heidelberg London New York

e-ISSN 1875-3493
e-ISBN 978-94-007-0289-9

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Cover design: VTEX, Vilnius

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The IUTAM Symposium on The Vibration Analysis of Structures with Uncertainties was held in Saint-Petersburg, Russia, on July 5 – July 9 2009. The members of the Scientific Committee were Alexander K. Belyaev (Chair) — Institute of Problems in Mechanical Engineering of the Russian Academy of Sciences, Saint-Petersburg, Russia; Robin Langley (Co-Chair) — University of Cambridge, UK; Franz Ziegler (IUTAM Representative) — Vienna University of Technology, Austria; Antonio Carcaterra — University of Rome La Sapienza, Italy; Yakov Ben-Haim — Technion-Israel Institute of Technology, Israel; Christian Soize — Universite de Marne-la-Vallee, France; Dirk Vandepitte — Katholieke Universiteit Leuven, Belgium and Richard Weaver — University of Illinois at Urbana-Champaign, USA.

The Symposium took place in Tsarskoe Selo in a palace designed by Prince Kochubei. Tsarkoe Selo (a suburb of St. Petersburg, also known as Pushkin) was a summer residence of the Tsar, and is well known for its many palaces, including the Katherine Palace which houses the famous Amber Room.

The Symposium was aimed at the theoretical and numerical problems involved in modelling the dynamic response of structures which have uncertain properties due to variability in the manufacturing and assembly process, with automotive and aerospace structures forming prime examples. It is well known that the difficulty in predicting the response statistics of such structures is immense, due to the complexity of the structure, the large number of variables which might be uncertain, and the inevitable lack of data regarding the statistical distribution of these variables. The Symposium participants presented the latest thinking in this very active research area, and novel techniques were presented covering the full frequency spectrum of low, mid, and high frequency vibration problems. It was demonstrated that for high frequency vibrations the response statistics can saturate and become independent of the detailed distribution of the uncertain system parameters. A number of presentations exploited this physical behaviour by using and extending methods originally developed in both phenomenological thermodynamics and in the fields of quantum mechanics and random matrix theory. For low frequency vibrations a number of presentations focussed on parametric uncertainty modelling (for example, probabilistic models, interval analysis, and fuzzy descriptions) and on methods of propagating

this uncertainty through a large dynamic model in an efficient way. At mid frequencies the problem is mixed, and various hybrid schemes were proposed. It is clear that a comprehensive solution to the problem of predicting the vibration response of uncertain structures across the whole frequency range requires expertise across a wide range of areas (including probabilistic and non-probabilistic methods, interval and info-gap analysis, statistical energy analysis, statistical thermodynamics, random wave approaches, and large scale computations) and this IUTAM symposium presented a unique opportunity to bring together outstanding international experts in these fields.

The lectures were arranged such that 12 of the presentations were keynote overviews and allocated 45 minutes, while the remaining 24 presentations were each allocated 20 minutes. In addition to this, there was much discussion and fruitful interaction, both during the technical sessions and over lunch and dinner. All of the presented papers are collected together in the Proceedings.

The IUTAM grant and the financial support of the Russian Foundation for Basic Research are gratefully acknowledged. Also, we would like to express our sincere gratitude to Dr Dmitry Kiryan who took the trouble of preparing the camera ready manuscript of the Proceedings. Robin Langley's participation was funded through the ITN Marie Curie project GA-214909 "MID-FREQUENCY – CAE Methodologies for Mid-Frequency Analysis in Vibration and Acoustics".

St. Petersburg, June 2010

Alexander K. Belyaev
Robin S. Langley
Symposium Co-Chairs

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