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NONDETERMINISTIC MECHANICS

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PREFACE

It has been recognized for several decades that uncertainty and absence of determinism play an important role in engineering sciences; to-date, three basic techniques have been developed to deal with various uncertainties, namely in variation and scatter in uncertain system parameters such as mechanical properties, geometric parameters, boundary conditions, in model uncertainties induced by modeling errors as well as actions such as the impact of earthquakes, wind loads, imperfect road profiles, or turbulence experienced by aircraft. These methodologies are (a) probabilistic or stochastic modeling; (b) fuzzy sets based analysis, and (c) anti-optimization of structures.

Spectacular advances have been recorded in stochastic mechanics based in the construction of stochastic models of uncertainties as soon as the probability theory can be used; likewise industrial applications have been developed worldwide in using fuzzy sets and logic for devising reliable machines and components, and a relatively recent new-old field has emerged, referred to as anti-optimization (also known as convex modeling of uncertainty, ellipsoidal modeling, guaranteed approach, maxmin, and worst case analysis)—that identifies uncertainty with boundedness. Interval analysis is the specific and simplest form of dealing with the best and worst scenarios under uncertainty. Imprecise probabilities combine both set and stochastic uncertainties, to obtain bounds of probabilities or expectations of variables.

However, the question which analysis is preferable for researchers and engineers is short of a consensus, as one can anticipate.

The aim of this book is to present the current state of the art of nondeterministic mechanics in its various forms. The topics range from stochastic problems to fuzzy sets; from linear to nonlinear problems; from specific methodologies to combinations of various techniques; from theoretical considerations to practical applications.

It is specially designed to illuminate the various aspects of above three techniques and deepen the discussion of their pros and cons.

The book is divided in three parts. Part 1 is devoted to stochastic analysis; it contains papers by Umberto Alibrandi and Giuseppe Ricciardi; Christian Soize; Isaac Elishakoff and Lova Andriamasy. Part 2 is devoted to nonstochastic analysis with papers by Thomas Haag and Michael Hanss; and by Alberto Bernardini and Fulvio Tonon.

Part 3 consists of one paper by Michael Oberguggenberger, dealing with combined methods.

If this volume stimulates further mutual and useful dialogue between proponents of differing methodologies, with demarcation of the area in which an approach ought to be preferred—our effort will be amply rewarded.

Isaac Elishakoff and Christian Soize, editors

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