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Book Review

Damage Prognosis For Aerospace, Civil And Mechanical Systems, D.J. Inman, C.R. Farrar, V. Lopes Jr., V. Steffen Jr. (Eds.). Wiley, Chichester, UK (2005). xix + 449pp., £70, US$120, ISBN: 0-470-86907-0

Damage prognosis

Damage prognosis is the estimation of a system's remaining useful life based on assessment of the current state of the system and prediction of the future loading environment for the system. It is an outgrowth of structural health monitoring, and incorporates hardware, software, modeling and analysis in support of its estimation. The multidisciplinary technologies needed to develop damage prognosis solutions certainly qualified it as one of the 'grand' engineering challenges of the 21st century, with broad appeal over a wide variety of civilian and defense infrastructures.

This book is an outgrowth of a workshop on damage prognosis held by the Pan American Advanced Studies Institute, in collaboration with the Los Alamos National Laboratories and sponsored by the US National Science Foundation. The list of 36 authors reads like a list of who's who working in the field of damage-related engineering problems. This book, with 20 chapters presented in four parts, is probably the most comprehensive book on damage prognosis to date. As each chapter was reviewed and revised based on feedback given by 30 advanced students during the workshop, this book is an easy read even for students interested in damage-related problems.

As this book is an outgrowth of a workshop, it very much follows the workshop's format of integrating various disciplines into four main parts after an introductory first chapter. The first part on damage models starts with an overview of modeling damage evolution in materials. This is followed by *in situ* observation of damage evolution and fracture toughness measurement by scanning electron microscopy, predictive modeling of crack propagation using the boundary element method, and friction-induced non-ideal vibration as a source of fatigue. It concludes with incorporating and updating of damping in the finite element modeling.

The second part on monitoring algorithms is the main part of the book with eight chapters. It commences with model-based inverse problems in structural dynamics, followed by structural health monitoring algorithms for smart structures, uncertainty quantification and the verification and validation of computational models. It also covers reliability methods for damage prognosis, Lamb-wave-based structural health monitoring, structural energy flow techniques, and impedance-based structural health monitoring. In addition, a statistical pattern recognition paradigm applied to defect detection in composite plates is described.

The third part on hardware examines the issues related to sensing and data acquisition for damage prognosis, followed by the design of active structural health monitoring systems for aircraft and spacecraft structures. An overview of the primary optical-based sensing techniques is also presented.

The final part is probably the most interesting for the experienced researchers as it describes several prognosis applications and examples. It also describes the prognosis of rotating machinery components, and an application of simplified statistical models in hydro-generating unit health monitoring.

Overall, this book is highly recommended to anyone beginning research in damage prognosis and as a text book for advanced courses in damage-related topics because the treatises are authoritative and up to date. Experienced researchers would also benefit from reading this book to find some recent applications on engineered systems and to update themselves on the newly introduced concepts. There are still many

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challenges in the emerging field of damage prognosis, hence we could look forward to more books from these editors as the field matures.

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