Random Vibrations in Space Structures Design—Theory and Applications
Jaap Wijker
Springer, NY (2009) 516 pp. hardbound 129.00 USD, ISBN 978-90-481-2727-6

This book on mechanical and acoustical vibrations experienced by space structures provides detailed explanations and is developed with illustrations of worked sample problems.

Deterministic and statistical dynamic systems in the low and high frequency range are covered. Particular emphasis is provided on deterministic linear mechanical dynamic system subjected to vibration due to acceleration and sound pressures, random vibration of statistically defined mechanical systems using statistical enginery analysis (SEA) and nonlinear structures excited by random mechanical loads analyzed using Fokker-Planck-Kolmogorov (FPK) equation.

The progression of the text begins with the basic concepts all engineers in the space industry are familiar with including Power Spectral Density (PSD) and the Discrete Fourier Transform (DFT). Part 1, the random mechanical vibration section, is very thorough and an excellent review for many engineers who work in the areas of vibration control and structural vibrations labs and would like a refresher on the theory and equations.

Part 2 addresses acoustic random vibrations in the lower frequency range using modal displacement method. The higher frequency vibrations response is covered in Part 3 statistical energy approach. The introduction and methods presented are key for those performing acoustical testing. Octave band and 1/3 octave bands are described along with acoustic test tailoring.

Part 3 continues with acoustic random vibration solved using the Statistical Energy Analysis and is a very good introduction to the SEA method and approach. While not as many engineers have the opportunity to develop SEA models, many of us work with the engineers who do. This is a good starter to understand the theory and approach to developing the SEA model and solution.

Part 4 introduces nonlinear dynamic systems and explores several methods to solve response based on random vibrations. This section is the most rigorous mathematically of all the sections due to the more complicated nature of nonlinear systems and the inability to apply simplifying benefits of the linear modal assumptions. The pace is measured with helpful examples of Fokker-Planck-Kolmogorov (FPK) method.

This text provides an excellent introduction to the wide range of topics required in vibration and acoustic engineering. Specific examples and explanations are provided as they apply to space structures design. The examples and problems insure the topics are covered in sufficient detail. The range of the topics prevents excessive detail in any one section—readers can find entire textbooks on each topic—but this is a benefit in this presentation. It allows the working engineer to get good in depth coverage of the features without the excessive details other texts have.

I recommend this book for the practicing engineer as well as students, it meets its purpose of providing the theory as well as practical applications for mechanical and acoustical vibrations of dynamic systems and how that applies to spacecraft design engineering.

Timothy J. Copeland
m+p international
Verona NJ USA
tim.copeland@mpina.com