Noise and Vibration Control in Automotive Bodies
Jian Pang
John Wiley & Sons Ltd under exclusive license granted by China Machine Press,
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK, (2022),
514 pp., ISBN 9781119515494 (hardback), ISBN 9781119515524 (epub)

1 PURPOSE

According to the author, "This book gives a comprehensive picture of the automotive body noise and vibration analysis and control." He further notes that "the combination of theory and practice . . . can provide a valuable reference for engineers, designers, researchers, and graduate students in the fields of automotive body design and NVH." A good way to characterize this book is as an overview of automotive interior NVH.

2 SUMMARY

This is a summary of vehicle interior noise and vibration. It is not a textbook. This volume does not provide technical depth in the techniques of modeling or measuring or in reducing vehicle noise or vibration. It provides a good high-level discussion of the noise and vibration issues specific to vehicles and the techniques often employed to control these issues. This book would be useful for those knowledgeable in noise and vibration who have not worked on vehicle NVH or those working in automotive engineering wanting to learn more about vehicle NVH without diving deeply into the technical details.

One negative to this book is that all the illustrations and photos are in grayscale. When showing mode shapes and other complex figures, it is difficult for the reader to interpret the images. This detracts significantly from the discussion in some places.

3 DISCUSSION

3.1 Chapter 1: Introduction

This is a comprehensive introduction to vehicle noise control with a thorough introduction of the topics to be covered in the subsequent chapters. For those unfamiliar with automotive noise and noise control, this will serve as a good starting point. Important topics introduced in this section include the terms used to describe the body and structure such as body in white and the basic concepts of airborne and structural sound transmission to the vehicle occupant. For the most part, the terminology and concepts used in this segment are common in the automotive industry. The reader who has some familiarity with vehicle NVH may wish to skip this chapter.

3.2 Chapter 2: Vibration Control of Overall Body Structure

This chapter provides an overview of body construction, vibration, and potential issues. The intended audience is unclear. The author discusses FEA and modal analysis with little explanation of what these terms mean and no real depth. On the other hand, talking about bending and torsion, the equations for uniform beam bending and torsion are presented. The result is an overview of body dynamics related to NVH with some information on typical stiffnesses, frequencies, and means to adjust stiffness. For those knowledgeable in noise and vibration but unfamiliar with automotive applications, this chapter would be helpful.

This is the first chapter where the illustrations being in grayscale prove to be a detriment. This makes it difficult to interpret structural mode shapes and other complex illustrations. This detracts from the utility of this text.

3.3 Chapter 3: Noise and Vibration Control for Local Body Structures

A comprehensive overview of body structural vibration and related noise issues is presented. The treatment is a little uneven with depth on topics like damping and panel sound radiation and less detailed discussion of FEA or BEM analysis. For the reader who is unfamiliar with automotive noise issues and their remediation, this would be an excellent primer.

There is a lot of material to cover, and it cannot be covered in great depth in the space available. Instead, the author provides some good examples and provides an overview of the range of contributions to interior noise from various structural components. There is a lot of useful material about cavity resonance, panel contribution analysis, and alternative solutions to local transmissibility and vibration issues.

3.4 Chapter 4: Sound Package

Although, this, like the other chapters, is an overview, it is comprehensive and provides a thorough introduction to vehicle interior sound treatments and the unique problems associated with automotive vehicles. There is a detailed discussion of leaks with a discussion of the various aspects related to sealing and sound insulation. The author includes a discussion of methods of leak detection. In describing the methods of insulation and sound absorption, the author discusses statistical energy analysis (SEA) and its use with automotive systems. Those familiar with noise

and vibration, but not familiar with automotive noise issues, would find this chapter particularly helpful.

3.5 Chapter 5: Vehicle Body Sensitivity Analysis and Control

The transfer of acoustic and mechanical energy through the vehicle surfaces and structure can be a complex topic. This chapter does an excellent job of presenting the basic concepts and providing a grounding in the primary transfer functions and paths in the vehicle. The concepts of order analysis and the impact of engine firing orders and gearing are introduced with useful examples. In addition, the use of SEA and impedances at various types of interfaces and connections are described. This is a comprehensive treatment at the intended level of depth.

3.6 Chapter 6: Wind Noise

The major topics related to aerodynamic noise generation, transmission, and related interior noise issues are described in this segment. The treatment identifies many of the areas of concern and devotes an appropriate amount of attention to sunroofs, side view mirrors, and door seals. Consistent with the previous chapters, the treatment of aerodynamic simulation is short on a few pages. Some of the key topics are introduced, but the details of modeling and the use in understanding aerodynamic noise are not addressed.

3.7 Chapter 7: Door Closing Sound Quality

This chapter is slightly misnamed. Despite the name, there is a thorough discussion of automotive sound quality along with a detailed presentation on door slam sound quality. This is the most technically detailed chapter in the book with the explanations of sound quality metrics and door slam dynamics and sound characteristics. This is one of the most useful chapters in the book. For those experienced with automotive NVH, this chapter may be a good place to start reading. I particularly like his categorization of NVH engineers work in three levels: "reducing vibration and noise, controlling sound quality, and designing branded sound."

Once again, the disappointing aspect of this chapter is the use of only grayscale illustrations and figures. This practice significantly reduces the clarity of the discussion and the usefulness to the reader.

3.8 Chapter 8: Squeak and Rattle Control in Vehicle Body

An excellent overview of automotive buzz, squeak, and rattle (BSR) is presented in this this chapter. The author discusses example problems and does a good job of explaining the nature and sources of these noise issues. The examples provided are not highly detailed, but they provide a good sense of the complexity of such problems and their diagnosis. The basic approach to measuring such noise issues is also presented. The use of simulation is also discussed but only in the broadest sense. The reader should not expect to see specific solutions to BSR problems. Instead, basic approaches and some simple examples in which common practices prevent BSR issues are discussed.

3.9 Chapter 9: Targets for Body Noise and Vibration

A brief overview of target setting is presented. The focus is primarily on categories and organization of tests and data. There is minimal discussion of simulation and related optimization techniques to balance source and path targets. This short chapter only provides the barest introduction to the complex and critical process of target setting for vehicles.

4 RECOMMENDATIONS

With the understanding that this is not an in-depth treatment of vehicle interior noise and vibration, this book could be helpful for those trying to become more familiar with the topic at a higher level. It is a comprehensive treatment of the subject without great technical depth. I would recommend this book to those who would want to learn more about vehicle NVH who are knowledgeable in noise and vibration technology. It is logically presented and very comprehensive at a high level in describing its topic.

The only reservation in recommending this book is that all the illustrations are in grayscale which makes understanding modal plots and complex spectra difficult. There are places where this detracts from the readers' understanding of the points being made by the author.

James K. Thompson, Ph D, PE, INCE Bd Cert.,
President, JKT Enterprises
JKT.JKTEnterprises@outlook.com