

# NVH analysis for hybrid powertrain integration

## LMS Engineering services reduces driveline vibrations by simultaneously optimizing mechanical systems and controls

### Benefits

- Reduce low-frequency torsional vibrations in the driveline
- Combine test and simulation methods to determine the root cause of problems
- Use 1D full-vehicle simulation, including mechanical systems and controls
- Define short-term mechanical hardware fixes or effective control-based solutions
- Keep the right performance for functional aspects, such as drivability, while optimizing the powertrain response for NVH

### Summary

LMS™ Engineering services combine test and simulation for integration of hybrid powertrains. By simultaneously designing mechanical systems and controls, low-frequency torsional driveline vibrations can be reduced.

The integration of eco-friendly hybrid powertrains presents new challenges to noise, vibration and harshness (NVH) engineers. Combining the increased cylinder pressure of downsized internal combustion engines (ICEs) with the high-torque ripples of electrical motors can cause low-frequency torsional vibrations, which are amplified in the driveline. As both mechanical components and system controls heavily influence this behavior, model-based troubleshooting is often the only feasible way to approach these issues. A scalable model-based systems

engineering approach helps engineers understand and solve NVH problems, and allows a balanced integration of the hybrid powertrain in the driveline.

NVH analysis for hybrid powertrain integration requires a combination of test and simulation technologies often dictated by the vehicle development stage and availability of representative data. If a physical prototype exists, engineers can start by measuring critical conditions and identifying the paths and components that contribute the most to problems. Afterwards, problems are replicated in 1D-simulation models.

These include scalable representations of subsystems, from functional to detailed, using tested or 3D-simulated input as well as control algorithms. They allow you to effectively evaluate countermeasures and control strategy optimization in the troubleshooting phase. Likewise in early development stages, the 1D approach can help to define the best conceptual architecture, balancing NVH with other functional requirements, such as drivability.



# Powertrain Systems Nvh S P Society Of Automotive Engineers

**John J. Moskwa, Scott A.  
Munns, Zachary J. Rubin, Society of  
Automotive Engineers**

## **Powertrain Systems Nvh S P Society Of Automotive Engineers:**

*Powertrain Systems NVH*.,2000      *Annual Index/abstracts of SAE Technical Papers* ,2007      *Automotive Engineering e-Mega Reference* David Crolla,2009-09-24 This one stop Mega Reference eBook brings together the essential professional reference content from leading international contributors in the automotive field An expansion the Automotive Engineering print edition this fully searchable electronic reference book of 2500 pages delivers content to meet all the main information needs of engineers working in vehicle design and development Material ranges from basic to advanced topics from engines and transmissions to vehicle dynamics and modelling A fully searchable Mega Reference Ebook providing all the essential material needed by Automotive Engineers on a day to day basis Fundamentals key techniques engineering best practice and rules of thumb together in one quick reference Over 2 500 pages of reference material including over 1 500 pages not included in the print edition      **Index of Conference Proceedings** British Library. Document Supply Centre,1998

*Vehicle Refinement* Matthew Harrison,2004-10-04 High standards of NVH Noise Vibration and Harshness performance are expected by consumers of all modern cars Refinement is one of the main engineering and design attributes to be addressed in the course of developing new vehicle models and vehicle components Written for students and engineering practitioners this is the first book to address automotive NVH It will help readers to understand and develop quieter more comfortable cars With chapters on the fundamentals of acoustics and detailed coverage of practical engineering solutions for noise control issues it is suitable for students of automotive engineering and engineers who haven t been trained in acoustics and will be an important reference for practicing engineers in the motor industry The first book devoted to the refinement of noise and vibration in automobiles Combines a detailed explanation of the fundamentals of acoustics and the science behind vehicle noise and vibration with practical tips and know how for noise and vibration control Based on real world experience with a variety of automotive companies including Ford BMW and Nissan      *Final Program* ,2000      [Annual Index/abstracts of SAE Technical Papers 2004](#) ,2005      [Technical Literature Abstracts](#) Society of Automotive Engineers,2000

**Automotive Engineering** ,1997      [Worldwide Automotive Supplier Directory](#) ,2007      **Vehicle Powertrain Systems** David Crolla,Behrooz Mashadi,2011-12-30 The powertrain is at the heart of vehicle design the engine whether it is a conventional hybrid or electric design provides the motive power which is then managed and controlled through the transmission and final drive components The overall powertrain system therefore defines the dynamic performance and character of the vehicle The design of the powertrain has conventionally been tackled by analyzing each of the subsystems individually and the individual components for example engine transmission and driveline have received considerable attention in textbooks over the past decades The key theme of this book is to take a systems approach to look at the integration of the components so that the whole powertrain system meets the demands of overall energy efficiency and good drivability Vehicle Powertrain Systems provides a thorough description and analysis of all the powertrain components and

then treats them together so that the overall performance of the vehicle can be understood and calculated The text is well supported by practical problems and worked examples Extensive use is made of the MATLAB R software and many example programmes for vehicle calculations are provided in the text Key features Structured approach to explaining the fundamentals of powertrain engineering Integration of powertrain components into overall vehicle design Emphasis on practical vehicle design issues Extensive use of practical problems and worked examples Provision of MATLAB R programmes for the reader to use in vehicle performance calculations This comprehensive and integrated analysis of vehicle powertrain engineering provides an invaluable resource for undergraduate and postgraduate automotive engineering students and is a useful reference for practicing engineers in the vehicle industry *Advanced Simulation Techniques for Optimization of Powertrain NVH and Fatigue Behaviour [i.e. Behavior]* Erich Payer, Society of Automotive Engineers, 1996

**Systems Engineering for Automotive Powertrain Development** Hannes Hick, Klaus Küpper, Helfried Sorger, 2021-02-25 For the last century the automotive industry has been dominated by internal combustion engines Their flexibility of application driving range performance and sporty characteristics has resulted in several generations of this technology and has formed generations of engineers But that is not the end of the story Stricter legislation and increased environmental awareness have resulted in the development of new powertrain technologies in addition and parallel to the highly optimized internal combustion engine Hybrid powertrains systems pure battery electric systems and fuel cell systems in conjunction with a diverse range of applications have increased the spectrum of powertrain technologies Furthermore automated driving together with intelligent and highly connected systems are changing the way to get from A to B Not only is the interaction of all these new technologies challenging but also several different disciplines have to collaborate intensively in order for new powertrain systems to be successfully developed These new technologies and the resulting challenges lead to an increase in system complexity Approaches such as systems engineering are necessary to manage this complexity To show how systems engineering manages the increasing complexity of modern powertrain systems by providing processes methods organizational aspects and tools this book has been structured into five parts Starting with Challenges for Powertrain Development which describes automotive related challenges at different levels of the system hierarchy and from different point of views The book then continues with the core part Systems Engineering in which all the basics of systems engineering model based systems engineering and their related processes methods tools and organizational matters are described A special focus is placed on important standards and the human factor The third part Automotive Powertrain Systems Engineering Approach puts the fundamentals of systems engineering into practice by adding the automotive context This part focuses on system development and also considers the interactions to hardware and software development Several approaches and methods are presented based on systems engineering philosophy Part four Powertrain Development Case Studies adds the practical point of view by providing a range of case studies on powertrain system level and on powertrain

element level and discusses the development of hybrid powertrain internal combustion engines e drives transmissions batteries and fuel cell systems Two case studies on a vehicle level are also presented The final part Outlook considers the development of systems engineering itself with particular focus on information communication technologies Even though this book covers systems engineering from an automotive perspective many of the challenges fundamental principles conclusions and outlooks can be applied to other domains too Therefore this book is not only relevant for automotive engineers and students but also for specialists in scientific and industrial positions in other domains and anyone who has to cope with the challenge of successfully developing complex systems with a large number of collaborating disciplines **Influence of**

**Powertrain Torsional Rigidity on NVH of 6x4 Trucks** Kei Suzuki,Yasushi Tozawa,Society of Automotive Engineers,1992

The Development of Vehicular Powertrain System Modeling Methodologies John J. Moskwa,Scott A. Munns,Zachary J. Rubin,Society of Automotive Engineers,1997 *Powertrain Systems for Net-Zero Transport* Institution of Mechanical Engineers (IME,2021-12-21 The transport sector continues to shift towards alternative powertrains particularly with the UK Government s announcement to end the sale of petrol and diesel passenger cars by 2030 and increasing support for alternatives Despite this announcement the internal combustion continues to play a significant role both in the passenger car market through the use of hybrids and sustainable low carbon fuels as well as a key role in other sectors such as heavy duty vehicles and off highway applications across the globe Building on the industry leading IC Engines conference the 2021 Powertrain Systems for Net Zero Transport conference 7 8 December 2021 London UK focussed on the internal combustion engine s role in Net Zero transport as well as covered developments in the wide range of propulsion systems available electric fuel cell sustainable fuels etc and their associated powertrains To achieve the net zero transport across the globe the life cycle analysis of future powertrain and energy was also discussed Powertrain Systems for Net Zero Transport provided a forum for engine fuels e machine fuel cell and powertrain experts to look closely at developments in powertrain technology required to meet the demands of the net zero future and global competition in all sectors of the road transportation off highway and stationary power industries **Automotive Powertrain Modeling, Simulation and Control Using**

**Integrated System's CASE Tools** Datta N. Godbole,S. Karahan,1994 *Benefits of Systems Engineering in Electronic*

*Powertrain Design* James W. Austin,Society of Automotive Engineers,1996 **An Analytical System of the Automobile**

**Powertrain Matching** He Ren,Gao Zong Ying,Society of Automotive Engineers,1993 *Issues in Commercial Vehicle Powertrain Design and Development* ,1996-01-01

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In a world inundated with screens and the cacophony of instant transmission, the profound power and emotional resonance of verbal art frequently fade in to obscurity, eclipsed by the regular barrage of noise and distractions. However, located within the musical pages of **Powertrain Systems Nvh S P Society Of Automotive Engineers**, a fascinating function of fictional beauty that pulses with fresh feelings, lies an unique trip waiting to be embarked upon. Written by way of a virtuoso wordsmith, this enchanting opus guides visitors on a mental odyssey, softly exposing the latent potential and profound impact stuck within the elaborate internet of language. Within the heart-wrenching expanse of this evocative evaluation, we will embark upon an introspective exploration of the book is main themes, dissect their captivating writing fashion, and immerse ourselves in the indelible impression it leaves upon the depths of readers souls.

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