NONLINEAR OPTIMIZATION OF VEHICLE SAFETY STRUCTURES

Modeling of Structures Subjected to Large Deformations

Jesper Christensen | Christophe Bastien

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Nonlinear Optimization Vehicle Safety Structures Ebook

James C. Fish

Nonlinear Optimization Vehicle Safety Structures Ebook:

Nonlinear Optimization of Vehicle Safety Structures Jesper Christensen,Christophe Bastien,2015-12-07 Nonlinear Optimization of Vehicle Safety Structures Modeling of Structures Subjected to Large Deformations provides a cutting edge overview of the latest optimization methods for vehicle structural design The book focuses on large deformation structural optimization algorithms and applications covering the basic principles of modern day topology optimization and comparing the benefits and flaws of different algorithms in use The complications of non linear optimization are highlighted along with the shortcomings of recently proposed algorithms Using industry relevant case studies users will how optimization software can be used to address challenging vehicle safety structure problems and how to explore the limitations of the approaches given The authors draw on research work with the likes of MIRA Jaguar Land Rover and Tata Motors European Technology Centre as part of multi million pound European funded research projects emphasizing the industry applications of recent advances The book is intended for crash engineers restraints system engineers and vehicle dynamics engineers as well as other mechanical automotive and aerospace engineers researchers and students with a structural focus Focuses on non linear large deformation structural optimization problems relating to vehicle safety Discusses the limitations of different algorithms in use and offers guidance on best practice approaches through the use of relevant case studies Author s present research from the cutting edge of the industry including research from leading European automotive companies and organizations Uses industry relevant case studies allowing users to understand how optimization software can be used to address challenging vehicle safety structure problems and how to explore the limitations of the approaches given

Proceedings of IAC in Budapest 2024 Group of Authors,2024-11-29 International Academic Conferences Global Education Teaching and Learning IAC GETL Management Economics Business and Marketing IAC MEBM Engineering Transport IT and Artificial Intelligence IAC ETITAI **Crashworthiness** Jorge A.C. Ambrosio,2014-05-04 From the fundamentals of impact mechanics and biomechanics to modern analysis and design techniques in impact energy management and occupant protection this book provides an overview of the application of nonlinear finite elements conceptual modeling and multibody procedures impact biomechanics injury mechanisms occupant mathematical modeling and human surrogates in crashworthiness *On the Development of a Process Chain for Structural Optimization in Vehicle Passive Safety* Jörgen Hilmann,2009 Optimization And Anti-optimization Of Structures Under Uncertainty Isaac E Elishakoff,Makoto Ohsaki,2010-03-08 The volume presents a collaboration between internationally recognized experts on anti optimization and structural optimization and summarizes various novel ideas methodologies and results studied over 20 years The book vividly demonstrates how the concept of uncertainty should be incorporated in a rigorous manner during the process of designing real world structures The necessity of anti optimization approach is first demonstrated then the anti optimization techniques are applied to static dynamic and buckling problems thus covering the broadest possible set of applications Finally anti

optimization is fully utilized by a combination of structural optimization to produce the optimal design considering the worst case scenario This is currently the only book that covers the combination of optimization and anti optimization It shows how various optimization techniques are used in the novel anti optimization technique and how the structural optimization can be exponentially enhanced by incorporating the concept of worst case scenario thereby increasing the safety of the structures designed in various fields of engineering a *Crashworthiness of Transportation Systems: Structural Impact and Occupant Protection* Jorge A.C. Ambrósio,Manuel F.O. Seabra Pereira,F. Pina da Silva,1997-02-28 A systematic treatment of current crashworthiness practice in the automotive railroad and aircraft industries Structural exterior and interior design occupant biomechanics seat and restraint systems are dealt with taking account of statistical data current regulations and state of the art design tool capabilities Occupant kinematics and biomechanics are reviewed leading to a basic understanding of human tolerance to impact and of the use of anthropometric test dummies and mathematical modelling techniques Different types of restraining systems are described in terms of impact biomechanics The material and structural behaviour of vehicle components is discussed in relation to crash testing A variety of commonly used techniques for simulating occupants and structures are presented in particular the use of multibody dynamics finite element methods and simplified macro elements in the context of design tools of increasing complexity which can be used to model both vehicles and occupants Audience An excellent reference for researchers engineers students and all other professionals involved in crashworthiness work

Optimization of Vehicle Safety Components M Heinritz,E Schreiter,Metals Society (MS), London (GB). British Industrial and Scientific International Translation Service,1985 **Engineering Optimization** Singiresu S. Rao,1996-02-29 In Engineering Optimization Professor Singiresu S Rao provides an application oriented presentation of the full array of classical and newly developed optimization techniques now being used by engineers in a wide range of industries

Multilevel Design Optimization of Automotive Structures Using Dummy- and Vehicle-based Responses Imtiaz Shareef Gandikota,2013 A computationally efficient multilevel decomposition and optimization framework is developed for application to automotive structures A full scale finite element FE model of a passenger car along with a dummy and occupant restraint system ORS is used to analyze crashworthiness and occupant safety criteria in two crash scenarios The vehicle and ORS models are incorporated into a decomposed multilevel framework and optimized with mass and occupant injury criteria as objectives A surrogate modeling technique is used to approximate the computationally expensive nonlinear FE responses A multilevel target matching optimization problem is formulated to obtain a design satisfying system level performance targets A balance is sought between crashworthiness and structural rigidity while minimizing overall mass of the vehicle Two separate design problems involving crash and crash vibration are considered A major finding of this study is that it is possible to achieve greater weight savings by including dummy based responses in optimization problem

Towards Functional Safety in Drive-by-Wire Vehicles Peter Johannes Bergmiller,2015-05-20 This book presents

approaches to address key challenges based on a vehicle level view and with a special emphasis on Drive by Wire systems The design and testing of modern vehicle electronics are becoming more and more demanding due to increasing interdependencies among components and the safety criticality of tasks The development towards Drive by Wire functionalities in vehicles with multiple actuators for vehicle control further increases the challenge The book explicitly takes into account the interactions between components and aims at bridging the gap between the need to generate additional customer benefits and the effort to achieve functional safety The book follows a twofold approach on the one side it presents a toolchain to support efficient further development of novel functionalities for Drive by Wire vehicles The toolchain comprises appropriate software tools and scaled and full scale experimental vehicles On the other side development towards functionally safe and flexible Drive by Wire vehicles is addressed by proposing a top down designed architecture for vehicle electronics that is enabled by suitable mechanisms The resulting goal achievement with regard to functional safety is evaluated based on a novel hierarchical approach **Design Optimization of Vehicle Structures for Crashworthiness Using Equivalent Mechanism Approximations** K. Hamza,K. Saitou,2005 A new method for crashworthiness optimization of vehicle structures is presented where an early design exploration is done by the optimization of an equivalent mechanism approximating a vehicle structure An equivalent mechanism is a network of rigid links with lumped mass connected by prismatic and revolute joints with nonlinear springs approximating aggregated behaviors of structural members A number of finite element FE models of the thin walled beams with typical cross sections and wall thicknesses are analyzed to build a surrogate model that maps a property of nonlinear spring to the corresponding FE model Using the surrogate model an equivalent mechanism is optimized for given design objectives by selecting the properties of the nonlinear springs among the values that can be realized by an FE model After the optimization the component FE models corresponding to the optimal spring properties are assembled into a FE model of an entire structure which is further modified for final tuning Two case studies of a vehicle front substructure are presented which demonstrate the approach can help obtain a better design with far less computational resources than the direct optimization of a FE model **Handbook of Automobile Passive Safety** Luigi Piano,2021-08 In this book are analyzed the most important aspects of automobile crashworthiness in frontal collision causes of injuries crash tests for the assessment of occupant protection biomechanics and dummy kinematics structural behavior of the vehicle In the last part are discussed the design criteria concerning the interior packaging the vehicle structure and the restraint systems The aim is to give an overall view of the topics to be addressed for an effective occupant protection and examples of design criteria for new vehicles This book is recommended to academics engineering students automotive designers people involved in crash test activity legislators involved in the development of road safety standards and to everyone interested in how a vehicle s safety is assessed Vehicle Aggressivity and Compatibility in Automotive Crashes ,1999 **Topology Design of Vehicle Structures for Crashworthiness Using Variable Design Time** Prasad

Tapkir,2017 The passenger safety is one of the most important factors in the automotive industries At the same time in order to improve the overall efficiency of passenger cars lightweight structures are preferred while designing the vehicle structures Among various structural optimization techniques topology optimization techniques are usually preferred to address the issue of crashworthiness The hybrid cellular automaton HCA is a truly nonlinear explicit topology design method developed for obtaining conceptual designs of crashworthy vehicle components In comparison to linear implicit methods such as equivalent static loads and partially nonlinear implicit methods the HCA method fully captures all the relevant aspect of a fully nonlinear transient dynamic crash simulation Traditionally the focus of the HCA method has been on designing load paths in the crash component that increase the uniform internal energy absorption ability thus far other relevant crashworthiness indicators such as peak crushing force and displacement have been less studied The objective of this research is to extend the HCA method to synthesize load paths to obtain the different acceleration displacement profiles which allow reduced peak crushing force as well as reduced penetration during a crash event To achieve this goal this work introduces the concept of achieving uniform energy distribution at variable design simulation times In the proposed work the design time is used as a new design parameter in topology optimization The desired volume fraction of the final design and the design time provided two dimensional design space for topology optimization which is followed by the formulation of design of experiments DOEs The nonlinear analyses of the corresponding DOEs are performed using nonlinear explicit code LS DYNA which is followed by topology synthesis in HCA The performance of the resulting structures showed that the short design times lead to design obtained by linear optimizers while long simulation times lead to designs obtained by the traditional HCA method To achieve the target crucial crash responses such as maximum acceleration and maximum displacement of the structure under the dynamic load the geological predictor has been implemented The concept of design time is further developed to improve structural performance of a vehicle component under the multiple loads using the method of multi design time Finally the design time is implemented to generated merged designs by performing binary operations on topology optimized designs Numerical example of the simplified front frame is utilized to demonstrate the capabilities of the proposed approach **Dynamics of Vehicles on Roads and Tracks Vol 2** Maksym Spiryagin,Timothy Gordon,Colin Cole,Tim McSweeney,2017-12-06 The International Symposium on Dynamics of Vehicles on Roads and Tracks is the leading international gathering of scientists and engineers from academia and industry in the field of ground vehicle dynamics to present and exchange their latest innovations and breakthroughs Established in Vienna in 1977 the International Association of Vehicle System Dynamics IAVSD has since held its biennial symposia throughout Europe and in the USA Canada Japan South Africa and China The main objectives of IAVSD are to promote the development of the science of vehicle dynamics and to encourage engineering applications of this field of science to inform scientists and engineers on the current state of the art in the field of vehicle dynamics and to broaden contacts among persons and organisations of the various

countries engaged in scientific research and development in the field of vehicle dynamics and related areas IAVSD 2017 the 25th Symposium of the International Association of Vehicle System Dynamics was hosted by the Centre for Railway Engineering at Central Queensland University Rockhampton Australia in August 2017 The symposium focused on the following topics related to road and rail vehicles and trains dynamics and stability vibration and comfort suspension steering traction and braking active safety systems advanced driver assistance systems autonomous road and rail vehicles adhesion and friction wheel rail contact tyre road interaction aerodynamics and crosswind pantograph catenary dynamics modelling and simulation driver vehicle interaction field and laboratory testing vehicle control and mechatronics performance and optimization instrumentation and condition monitoring and environmental considerations Providing a comprehensive review of the latest innovative developments and practical applications in road and rail vehicle dynamics the 213 papers now published in these proceedings will contribute greatly to a better understanding of related problems and will serve as a reference for researchers and engineers active in this specialised field Volume 2 contains 135 papers under the subject heading Rail Design Optimization of Vehicle Structures for Crashworthiness Improvement Hesham Kamel Ibrahim,2009 The complicated nature of the physical crash processes of complex vehicle structures makes design optimization for crashworthiness a very challenging task Moreover large scale and highly nonlinear nature of crashworthiness simulations of vehicle structure make it impractical to conduct direct optimization on the full nonlinear model of the structure The main objective of the thesis is to present a systematic and practical methodology to conduct vehicle crashworthiness design optimization efficiently at early stages of design The thesis includes four main parts In the first part an efficient and practical methodology for design optimization of vehicle structures under frontal impact for crashworthiness improvement is presented The proposed methodology is based on identifying the main vehicle structural part contributing most to the total amount of impact energy absorbed in the whole vehicle structure The computationally efficient surrogate model of expensive nonlinear finite element simulation of this major vehicle part is developed and then integrated with gradient based optimization algorithm to maximize its absorbed impact energy while guarding against increase in its weight In the second part a methodology for deriving the important relation between minimum structural weight and maximum impact energy is presented The proposed methodology is based on the principle of the Pareto front and multiobjective optimization The methodology enables the designer to evaluate the crashworthiness performance of any suggested design easily and effectively Moreover the methodology provides different optimum designs from which the designer can easily select the optimum design variables to improve the performance of the initial design In the third part the crashworthiness behavior of simple thin walled structures and vehicle structural components made of magnesium due to its light weight is examined and a new methodology for material design optimization is presented The proposed methodology adds material type as design variables to formal size design variables Direct optimization using the genetic algorithm is conducted to find the optimum

material combination and part s thicknesses to improve the crashworthiness performance of the vehicle structure Finally in the fourth part the effect of imperfection on crush elements performance is studied Different imperfection configurations are proposed to improve the crashworthiness performance of crush elements The genetic algorithm is directly combined with nonlinear finite elements models to search for optimum imperfection values The results show that the crashworthiness performance of crush elements can be greatly improved through introduction of proper imperfection Using the proposed methodologies the current research presents a fundamental and systematic study to conduct design optimization of vehicle structures practically and efficiently **Structural Optimization and the Use of Linear and Nonlinear Programs** James C. Fish,1992 *Structural Optimization of Thin Walled Tubular Structure for Crashworthiness* Satyajeet Suresh Shinde,2014 Crashworthiness design is gaining more importance in the automotive industry due to high competition and tight safety norms Further there is a need for light weight structures in the automotive design Structural optimization in last two decades have been widely explored to improve existing designs or conceive new designs with better crashworthiness and reduced mass Although many gradient based and heuristic methods for topology and topometry based crashworthiness design are available these days most of them result in stiff structures that are suitable only for a set of vehicle components in which maximizing the energy absorption or minimizing the intrusion is the main concern However there are some other components in a vehicle structure that should have characteristics of both stiffness and flexibility Moreover the load paths within the structure and potential buckle modes also play an important role in efficient functioning of such components For example the front bumper side frame rails steering column and occupant protection devices like the knee bolster should all exhibit controlled deformation and collapse behavior This investigation introduces a methodology to design dynamically crushed thin walled tubular structures for crashworthiness applications Due to their low cost high energy absorption efficiency and capacity to withstand long strokes thin walled tubular structures are extensively used in the automotive industry Tubular structures subjected to impact loading may undergo three modes of deformation progressive crushing buckling dynamic plastic buckling and global bending or Euler type buckling Of these progressive buckling is the most desirable mode of collapse because it leads to a desirable deformation characteristic low peak reaction force and higher energy absorption efficiency Progressive buckling is generally observed under pure axial loading however during an actual crash event tubular structures are often subjected to oblique impact loads in which Euler type buckling is the dominating mode of deformation This undesired behavior severely reduces the energy absorption capability of the tubular structure The design methodology presented in this paper relies on the ability of a compliant mechanism to transfer displacement and or force from an input to desired output port locations The suitable output port locations are utilized to enforce desired buckle zones mitigating the natural Euler type buckling effect The problem addressed in this investigation is to find the thickness distribution of a thin walled structure and the output port locations that maximizes the energy absorption while maintaining

the peak reaction force at a prescribed limit The underlying design for thickness distribution follows a uniform mutual potential energy density under a dynamic impact event Nonlinear explicit finite element code LS DYNA is used to simulate tubular structures under crash loading Biologically inspired hybrid cellular automaton HCA method is used to drive the design process Results are demonstrated on long straight and S rail tubes subject to oblique loading achieving progressive crushing in most cases Optimization Methods for Vehicle Body Structures Harald A. Fredricson,2002

The Engaging Realm of Kindle Books: A Comprehensive Guide Unveiling the Pros of E-book Books: A Realm of Convenience and Flexibility E-book books, with their inherent portability and simplicity of access, have freed readers from the constraints of hardcopy books. Done are the days of lugging cumbersome novels or meticulously searching for particular titles in shops. E-book devices, stylish and portable, seamlessly store an wide library of books, allowing readers to immerse in their favorite reads whenever, anywhere. Whether traveling on a busy train, lounging on a sunny beach, or just cozying up in bed, Kindle books provide an exceptional level of convenience. A Reading World Unfolded: Exploring the Vast Array of Kindle Nonlinear Optimization Vehicle Safety Structures Ebook Nonlinear Optimization Vehicle Safety Structures Ebook The Kindle Store, a digital treasure trove of literary gems, boasts an extensive collection of books spanning varied genres, catering to every readers taste and preference. From gripping fiction and mind-stimulating non-fiction to classic classics and modern bestsellers, the E-book Store offers an unparalleled variety of titles to discover. Whether seeking escape through engrossing tales of fantasy and exploration, delving into the depths of historical narratives, or expanding ones understanding with insightful works of science and philosophy, the E-book Shop provides a doorway to a bookish universe brimming with endless possibilities. A Revolutionary Factor in the Bookish Scene: The Lasting Impact of Kindle Books Nonlinear Optimization Vehicle Safety Structures Ebook The advent of Kindle books has undoubtedly reshaped the bookish scene, introducing a paradigm shift in the way books are published, disseminated, and read. Traditional publishing houses have embraced the online revolution, adapting their approaches to accommodate the growing demand for e-books. This has led to a rise in the accessibility of E-book titles, ensuring that readers have access to a vast array of literary works at their fingertips. Moreover, Kindle books have equalized access to books, breaking down geographical limits and offering readers worldwide with similar opportunities to engage with the written word. Irrespective of their location or socioeconomic background, individuals can now engross themselves in the intriguing world of literature, fostering a global community of readers. Conclusion: Embracing the Kindle Experience Nonlinear Optimization Vehicle Safety Structures Ebook Kindle books Nonlinear Optimization Vehicle Safety Structures Ebook, with their inherent convenience, flexibility, and vast array of titles, have certainly transformed the way we experience literature. They offer readers the liberty to explore the boundless realm of written expression, whenever, everywhere. As we continue to navigate the ever-evolving online landscape, Kindle books stand as testament to the lasting power of storytelling, ensuring that the joy of reading remains accessible to all.

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