

# Electric Vehicle Machines And Drives Design Analysis And Application

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## **Multiphysics Simulation by Design for Electrical Machines, Power**

**Electronics and Drives** Dr. Marius Rosu 2017-11-20 Presents applied theory and advanced simulation techniques for electric machines and

drives This book combines the knowledge of experts from both academia and the software industry to present theories of multiphysics simulation by design for electrical machines, power electronics, and drives. The comprehensive design

approach described within supports new applications required by technologies sustaining high drive efficiency. The highlighted framework considers the electric machine at the heart of the entire electric drive. The book also emphasizes the simulation by design concept—a concept that frames the entire highlighted design methodology, which is described and illustrated by various advanced simulation technologies. *Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives* begins with the basics of electrical machine design and manufacturing tolerances. It also discusses fundamental aspects of the state of the art design process and includes examples from industrial practice. It explains FEM-based analysis techniques for electrical machine design—providing details on how it can be employed in ANSYS Maxwell software. In addition, the book covers advanced magnetic

material modeling capabilities employed in numerical computation; thermal analysis; automated optimization for electric machines; and power electronics and drive systems. This valuable resource: Delivers the multi-physics know-how based on practical electric machine design methodologies Provides an extensive overview of electric machine design optimization and its integration with power electronics and drives Incorporates case studies from industrial practice and research and development projects *Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives* is an incredibly helpful book for design engineers, application and system engineers, and technical professionals. It will also benefit graduate engineering students with a strong interest in electric machines and drives.

*Switched Reluctance Motor Drives*  
Berker Bilgin 2019-04-29 Electric

motors are the largest consumer of electric energy and they play a critical role in the growing market for electrification. Due to their simple construction, switched reluctance motors (SRMs) are exceptionally attractive for the industry to respond to the increasing demand for high-efficiency, high-performance, and low-cost electric motors with a more secure supply chain. Switched Reluctance Motor Drives: Fundamentals to Applications is a comprehensive textbook covering the major aspects of switched reluctance motor drives. It provides an overview of the use of electric motors in the industrial, residential, commercial, and transportation sectors. It explains the theory behind the operation of switched reluctance motors and provides models to analyze them. The book extensively concentrates on the fundamentals and applications of SRM design and covers various design

details, such as materials, mechanical construction, and controls. Acoustic noise and vibration is the most well-known issue in switched reluctance motors, but this can be reduced significantly through a multidisciplinary approach. These methodologies are explained in two chapters of the book. The first covers the fundamentals of acoustic noise and vibration so readers have the necessary tools to analyze the problems and explains the surface waves, spring-mass models, forcing harmonics, and mode shapes that are utilized in modeling and analyzing acoustic noise and vibration. The second applies these fundamentals to switched reluctance motors and provides examples for determining the sources of any acoustic noise in switched reluctance motors. In the final chapter two SRM designs are presented and proposed as replacements for permanent magnet machines in a residential HVAC

application and a hybrid-electric propulsion application. It also shows a high-power and compact converter design for SRM drives. Features: Comprehensive coverage of switched reluctance motor drives from fundamental principles to design, operation, and applications A specific chapter on electric motor usage in industrial, residential, commercial, and transportation applications to address the benefits of switched reluctance machines Two chapters address acoustic noise and vibration in detail Numerous illustrations and practical examples on the design, modeling, and analysis of switched reluctance motor drives Examples of switched reluctance motor and drive design

Hybrid Electric Vehicles Chris Mi  
2017-11-29 The latest developments in the field of hybrid electric vehicles Hybrid Electric Vehicles provides an introduction to hybrid vehicles, which include purely electric, hybrid

electric, hybrid hydraulic, fuel cell vehicles, plug-in hybrid electric, and off-road hybrid vehicular systems. It focuses on the power and propulsion systems for these vehicles, including issues related to power and energy management. Other topics covered include hybrid vs. pure electric, HEV system architecture (including plug-in & charging control and hydraulic), off-road and other industrial utility vehicles, safety and EMC, storage technologies, vehicular power and energy management, diagnostics and prognostics, and electromechanical vibration issues. Hybrid Electric Vehicles, Second Edition is a comprehensively updated new edition with four new chapters covering recent advances in hybrid vehicle technology. New areas covered include battery modelling, charger design, and wireless charging. Substantial details have also been included on the architecture of hybrid excavators

in the chapter related to special hybrid vehicles. Also included is a chapter providing an overview of hybrid vehicle technology, which offers a perspective on the current debate on sustainability and the environmental impact of hybrid and electric vehicle technology. Completely updated with new chapters Covers recent developments, breakthroughs, and technologies, including new drive topologies Explains HEV fundamentals and applications Offers a holistic perspective on vehicle electrification Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Second Edition is a great resource for researchers and practitioners in the automotive industry, as well as for graduate students in automotive engineering.

### **Electric Vehicle Machines and Drives**

K. T. Chau 2015-05-26 A timely comprehensive reference consolidates

the research and development of electric vehicle machines and drives for electric and hybrid propulsions • Focuses on electric vehicle machines and drives • Covers the major technologies in the area including fundamental concepts and applications • Emphasis the design criteria, performance analyses and application examples or potentials of various motor drives and machine systems • Accompanying website includes the simulation models and outcomes as supplementary material

*Reluctance Electric Machines* Ion Boldea 2018-07-20 Electric energy is arguably a key agent for our material prosperity. With the notable exception of photovoltaic generators, electric generators are exclusively used to produce electric energy from mechanical energy. More than 60% of all electric energy is used in electric motors for useful mechanical work in various industries. This book presents the modeling, performance,

design, and control of reluctance synchronous and flux-modulation machines developed for higher efficiency and lower cost. It covers one- and three-phase reluctance synchronous motors in line-start applications and various reluctance flux-modulation motors in pulse width modulation converter-fed variable speed drives. "Reluctance motor drives start to find their rightful place in the adjustable speed motor drives. This is in part due to their lower cost, ease of cooling, higher fault tolerance, and suitability for use under harsh operating and ambient condition. The book by Prof. Boldea and Prof. Tutelea offers a physically insightful approach to electromechanical energy conversion in this family of electric machines. Authors provide an in-depth explanation of the electromagnetic performance, interdependence between control and magnetic design and fundamentals of design. I found this

book to be a great resource for practicing engineers in industry and researchers in academia. There is an outstanding balance between the theoretical contents and engineering aspects of design and control throughout the manuscript which makes this book an excellent choice for a graduate course in academic institutions or series of short courses for practicing engineers in the industry. I would like to strongly recommend this book for researchers and practitioners in the area of electric machines." -Babak Fahimi, Distinguished Chair of Engineering at University of Texas at Dallas, USA Presents basic and up-to-date knowledge about the topologies, modeling, performance, design, and control of reluctance synchronous machines. Includes information on recently introduced reluctance flux-modulation electric machines (switched- flux, flux-reversal, Vernier, transverse flux, claw pole,

magnetic-g geared dual-rotor, brushless doubly fed, etc.). Features numerous examples and case studies throughout. Provides a comprehensive overview of all reluctance electric machines.

**Handbook of Automotive Power Electronics and Motor Drives** Ali Emadi 2017-12-19 Initially, the only electric loads encountered in an automobile were for lighting and the starter motor. Today, demands on performance, safety, emissions, comfort, convenience, entertainment, and communications have seen the working-in of seemingly innumerable advanced electronic devices. Consequently, vehicle electric systems require larger capacities and more complex configurations to deal with these demands. Covering applications in conventional, hybrid-electric, and electric vehicles, the Handbook of Automotive Power Electronics and Motor Drives provides a comprehensive reference for automotive electrical systems. This

authoritative handbook features contributions from an outstanding international panel of experts from industry and academia, highlighting existing and emerging technologies. Divided into five parts, the Handbook of Automotive Power Electronics and Motor Drives offers an overview of automotive power systems, discusses semiconductor devices, sensors, and other components, explains different power electronic converters, examines electric machines and associated drives, and details various advanced electrical loads as well as battery technology for automobile applications. As we seek to answer the call for safer, more efficient, and lower-emission vehicles from regulators and consumer insistence on better performance, comfort, and entertainment, the technologies outlined in this book are vital for engineering advanced vehicles that will satisfy these criteria.

**Modeling and Simulation for Electric**

**Vehicle Applications** Mohamed Amine Fakhfakh 2016-10-05 The book presents interesting topics from the area of modeling and simulation of electric vehicles application. The results presented by the authors of the book chapters are very interesting and inspiring. The book will familiarize the readers with the solutions and enable the readers to enlarge them by their own research. It will be useful for students of Electrical Engineering; it helps them solve practical problems.

International Advanced Researches & Engineering Congress 2017 Proceeding Book Recep HALICIOGLU 2017-12-29 INTERNATIONAL WORKSHOPS (at IAREC'17) (This book includes English (main) and Turkish languages) International Workshop on Mechanical Engineering International Workshop on Mechatronics Engineering International Workshop on Energy Systems Engineering International Workshop on Automotive Engineering

and Aerospace Engineering International Workshop on Material Engineering International Workshop on Manufacturing Engineering International Workshop on Physics Engineering International Workshop on Electrical and Electronics Engineering International Workshop on Computer Engineering and Software Engineering International Workshop on Chemical Engineering International Workshop on Textile Engineering International Workshop on Architecture International Workshop on Civil Engineering International Workshop on Geomatics Engineering International Workshop on Industrial Engineering International Workshop on Food Engineering International Workshop on Aquaculture Engineering International Workshop on Agriculture Engineering International Workshop on Mathematics Engineering International Workshop on Bioengineering Engineering International Workshop on Biomedical Engineering International

Workshop on Genetic Engineering  
International Workshop on  
Environmental Engineering  
International Workshop on Other  
Engineering Science

**Electric Machines and Drives** Ned Mohan 2011-12-13 This book is part of a three-book series. Ned Mohan has been a leader in EES education and research for decades, as author of the best-selling text/reference Power Electronics. This book emphasizes applications of electric machines and drives that are essential for wind turbines and electric and hybrid-electric vehicles. The approach taken is unique in the following respects: A systems approach, where Electric Machines are covered in the context of the overall drives with applications that students can appreciate and get enthusiastic about; A fundamental and physics-based approach that not only teaches the analysis of electric machines and drives, but also prepares students

for learning how to control them in a graduate level course; Use of the space-vector-theory that is made easy to understand. They are introduced in this book in such a way that students can appreciate their physical basis; A unique way to describe induction machines that clearly shows how they go from the motoring-mode to the generating-mode, for example in wind and electric vehicle applications, and how they ought to be controlled for the most efficient operation.

**Electric Vehicle Technology Explained**

James Larminie 2012-09-17  
*Axial Flux Permanent Magnet Brushless Machines* Jacek F. Gieras 2006-01-16  
Axial Flux Permanent Magnet (AFPM) brushless machines are modern electrical machines with a lot of advantageous merits over their conventional counterparts. They are increasingly used in power generation, domestic appliances, industrial drives, electric vehicles, and marine propulsion drives and many

other applications. This book deals with the analysis, construction, design, optimisation, control and applications of AFPM machines. The authors present their own research results, as well as significant research contributions made by others. This monograph will be of interest to electrical engineers and other engineers involved in the design and application of AFPM brushless machine drives. It will be an important resource for researchers and graduate students in the field of electrical machine and drives.

*Electric and Hybrid Vehicles* Iqbal Husain 2021-02-22 A thoroughly revised third edition of this widely praised, bestselling textbook presents a comprehensive systems-level perspective of electric and hybrid vehicles with emphasis on technical aspects, mathematical relationships and basic design guidelines. The emerging technologies of electric vehicles require the

dedication of current and future engineers, so the target audience for the book is the young professionals and students in engineering eager to learn about the area. The book is concise and clear, its mathematics are kept to a necessary minimum and it contains a well-balanced set of contents of the complex technology. Engineers of multiple disciplines can either get a broader overview or explore in depth a particular aspect of electric or hybrid vehicles. Additions in the third edition include simulation-based design analysis of electric and hybrid vehicles and their powertrain components, particularly that of traction inverters, electric machines and motor drives. The technology trends to incorporate wide bandgap power electronics and reduced rare-earth permanent magnet electric machines in the powertrain components have been highlighted. Charging stations are a critical component for

the electric vehicle infrastructure, and hence, a chapter on vehicle interactions with the power grid has been added. Autonomous driving is another emerging technology, and a chapter is included describing the autonomous driving system architecture and the hardware and software needs for such systems. The platform has been set in this book for system-level simulations to develop models using various softwares used in academia and industry, such as MATLAB®/Simulink, PLECS, PSIM, Motor-CAD and Altair Flux. Examples and simulation results are provided in this edition using these software tools. The third edition is a timely revision and contribution to the field of electric vehicles that has reached recently notable markets in a more and more environmentally sensitive world.

### **Practical Control of Electric Machines** Rubén Molina Llorente

2020-03-20 This book presents deep

analysis of machine control for different applications, focusing on its implementation in embedded systems. Necessary peripherals for various microcontroller families are analysed for machine control and software architecture patterns for high-quality software development processes in motor control units are described. Abundant figures help the reader to understand the theoretical, simulation and practical implementation stages of machine control. Model-based design, used as a mathematical and visual approach to construction of complex control algorithms, code generation that eliminates hand-coding errors, and co-simulation tools such as Simulink, PSIM and finite element analysis are discussed. The simulation and verification tools refine, and retest the models without having to resort to prototype construction. The book shows how a voltage source inverter can be designed with tricks,

protection elements, and space vector modulation. Practical Control of Electric Machines: Model-Based Design and Simulation is based on the author's experience of a wide variety of systems in domestic, automotive and industrial environments, and most examples have implemented and verified controls. The text is ideal for readers looking for an insight into how electric machines play an important role in most real-life applications of control. Practitioners and students preparing for a career in control design applied in electric machines will benefit from the book's easily understood theoretical approach to complex machine control. The book contains mathematics appropriate to various levels of experience, from the student to the academic and the experienced professional. Advances in Industrial Control reports and encourages the transfer of technology in control engineering. The rapid

development of control technology has an impact on all areas of the control discipline. The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control.

### **Design, Analysis and Application of Magnetless Doubly Salient Machines**

Christopher H. T. Lee 2018-01-22 This thesis investigates the key characteristics of magnetless doubly salient machines, evaluates their design philosophies, and proposes new topologies for various applications. It discusses the background of and previous research on magnetless machines, while also outlining upcoming trends and potential future developments. The thesis begins by presenting various torque-improving structures - namely the multi-tooth structure, the double-rotor (DR) structure, the axial-field (AF) structure, and the flux-reversal (FR) structure - for magnetless machines.

It subsequently addresses the idea of merging the design philosophies of two different machines to form new dual-mode machines. Thanks to a reconfigured winding arrangement and controllable DC-field excitation, the proposed machines can further extend their operating range to meet the extreme demands of applications in electric vehicles and wind power generation. Lastly, the thesis employs the finite element method (FEM) to thoroughly analyze the proposed machines' key performance parameters and develops experimental setups to verify the proposed concepts.

**Emerging Solutions for e-Mobility and Smart Grids** V. Kamaraj 2021-05-07

This book presents select proceedings of the International Conference on Renewable Energy Systems (ICRES 2020). It focuses mainly on the concepts of electric vehicle, selection of batteries, selection of electric motors for specific capacity

vehicles, design of controllers, battery chargers and development of testing facility. It presents the importance of energy storage system and modeling aspects of battery, super capacitor, flywheel energy storage and Superconducting magnetic energy storage systems. The book comprehensively presents the integration of renewable energy sources with smart grid, smart grid technologies and equipment, grid interconnection issues and design of intelligent controllers for grid connected system. The state-of-the-art technologies such as charging infrastructure for electric vehicles, robotic applications in energy, energy education and informatics are also covered in this book. This book will benefit the students and researchers in the field of electronics and electrical engineering, energy engineering, automotive engineering, e-mobility specialists and industrial experts.

**Electromagnetic Compatibility of Electric Vehicle** Li Zhai 2021-01-30

This book introduces the electromagnetic compatibility(EMC) of electric vehicle(EV), including EMC of the whole vehicle, electromagnetic interference(EMI) prediction and suppression of motor drive system, EMI prediction and suppression of DC-DC converter, electromagnetic field safety and EMC of wireless charging system, signal integrity and EMC of the vehicle controller unit(VCU), EMC of battery management system(BMS), electromagnetic radiated emission diagnosis and suppression of the whole vehicle, etc. The analysis method, modeling and simulation method, test method and rectification method of EMC are demonstrated. The simulation and experimental results are presented as tables and figures. This book is useful as reference for graduate students, senior undergraduates and engineering technicians of vehicle engineering

related majors. For EMI prediction, suppression and EMC optimization design for EVs, this book provides reference for engineers to solve EMC problems. This book is intended for senior undergraduates, postgraduates, lecturers and laboratory researchers engaged in electric vehicle and electromagnetic compatibility research.

**Switched Reluctance Motor** Ahmed Tahour 2017-06-21 In the last years, the switched reluctance machines (SRMs) have been the subject of significant developments. SRMs are gaining much interest because of their simplicity in structures, high-output power, high starting torque, wide speed range, rugged and robust construction, reliability, and low manufacturing costs, which make these machines viable for many applications. SRMs include machines of different structures whose common property is the significant variation in the shape of the air gap during

rotation. The use of advanced control technologies makes possible the integration of the mechanical and electrical conversion systems in their optimal mode of operation. Different strategies of control can be applied to SRMs, depending on their mode of functioning and the purpose of their applications. The goal of this book is to present recent works on concept, control, and applications in switched reluctance machines.

Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance Richard Folkson 2014-03-19 Most vehicles run on fossil fuels, and this presents a major emissions problem as demand for fuel continues to increase. Alternative Fuels and Advanced Vehicle Technologies gives an overview of key developments in advanced fuels and vehicle technologies to improve the energy efficiency and environmental impact

of the automotive sector. Part I considers the role of alternative fuels such as electricity, alcohol, and hydrogen fuel cells, as well as advanced additives and oils, in environmentally sustainable transport. Part II explores methods of revising engine and vehicle design to improve environmental performance and fuel economy. It contains chapters on improvements in design, aerodynamics, combustion, and transmission. Finally, Part III outlines developments in electric and hybrid vehicle technologies, and provides an overview of the benefits and limitations of these vehicles in terms of their environmental impact, safety, cost, and design practicalities. Alternative Fuels and Advanced Vehicle Technologies is a standard reference for professionals, engineers, and researchers in the automotive sector, as well as vehicle manufacturers, fuel system developers, and academics with an

interest in this field. Provides a broad-ranging review of recent research into advanced fuels and vehicle technologies that will be instrumental in improving the energy efficiency and environmental impact of the automotive sector Reviews the development of alternative fuels, more efficient engines, and powertrain technologies, as well as hybrid and electric vehicle technologies

*Lightweight Electric/Hybrid Vehicle Design* John Fenton 2001 *Lightweight Electric/Hybrid Vehicle Design*, covers the particular automotive design approach required for hybrid/electrical drive vehicles. There is currently huge investment world-wide in electric vehicle propulsion, driven by concern for pollution control and depleting oil resources. The radically different design demands of these new vehicles requires a completely new approach that is covered comprehensively in

this book. The book explores the rather dramatic departures in structural configuration necessary for purpose-designed electric vehicle including weight removal in the mechanical systems. It also provides a comprehensive review of the design process in the electric hybrid drive and energy storage systems. Ideal for automotive engineering students and professionals *Lightweight Electric/Hybrid Vehicle Design* provides a complete introduction to this important new sector of the industry. comprehensive coverage of all design aspects of electric/hybrid cars in a single volume packed with case studies and applications in-depth treatment written in a text book style (rather than a theoretical specialist text style) *Energy Efficiency in Electric Devices, Machines and Drives* Gorazd Štumberger 2020-06-18 This Special Issue deals with improvements in the energy efficiency of electric

devices, machines, and drives, which are achieved through improvements in the design, modelling, control, and operation of the system. Properly sized and placed coils of a welding transformer can reduce the required iron core size and improve the efficiency of the welding system operation. New structures of the single-phase field excited flux switching machine improve its performance in terms of torque, while having higher back-EMF and unbalanced electromagnetic forces. A properly designed rotor notch reduces the torque ripple and cogging torque of interior permanent magnet motors for the drive platform of electric vehicles, resulting in lower vibrations and noise. In the field of modelling, the torque estimation of a Halbach array surface permanent magnet motor with a non-overlapping winding layout was improved by introducing an analytical two-dimensional subdomain model. A

general method for determining the magnetically nonlinear two-axis dynamic models of rotary and linear synchronous reluctance machines and synchronous permanent magnet machines is introduced that considers the effects of slotting, mutual interaction between the slots and permanent magnets, saturation, cross saturation, and end effects. Advanced modern control solutions, such as neural network-based model reference adaptive control, fuzzy control, senseless control, torque/speed tracking control derived from the 3D non-holonomic integrator, including drift terms, maximum torque per ampere, and maximum efficiency characteristics, are applied to improve drive performance and overall system operation.

Advanced Electric Drives Ned Mohan  
2014-07-22 With nearly two-thirds of global electricity consumed by electric motors, it should come as no surprise that their proper control

represents appreciable energy savings. The efficient use of electric drives also has far-reaching applications in such areas as factory automation (robotics), clean transportation (hybrid-electric vehicles), and renewable (wind and solar) energy resource management. Advanced Electric Drives utilizes a physics-based approach to explain the fundamental concepts of modern electric drive control and its operation under dynamic conditions. Author Ned Mohan, a decades-long leader in Electrical Energy Systems (EES) education and research, reveals how the investment of proper controls, advanced MATLAB and Simulink simulations, and careful forethought in the design of energy systems translates to significant savings in energy and dollars. Offering students a fresh alternative to standard mathematical treatments of dq-axis transformation of a-b-c phase quantities, Mohan's unique

physics-based approach "visualizes" a set of representative dq windings along an orthogonal set of axes and then relates their currents and voltages to the a-b-c phase quantities. Advanced Electric Drives is an invaluable resource to facilitate an understanding of the analysis, control, and modelling of electric machines. • Gives readers a "physical" picture of electric machines and drives without resorting to mathematical transformations for easy visualization • Confirms the physics-based analysis of electric drives mathematically • Provides readers with an analysis of electric machines in a way that can be easily interfaced to common power electronic converters and controlled using any control scheme • Makes the MATLAB/Simulink files used in examples available to anyone in an accompanying website • Reinforces fundamentals with a variety of discussion questions, concept

quizzes, and homework problems

**Sustainable Automotive Technologies 2012** Aleksandar Subic 2012-03-02 The book on Sustainable Automotive Technologies aims to draw special attention to the research and practice focused on new technologies and approaches capable of meeting the challenges to sustainable mobility. In particular, the book features incremental and radical technical advancements that are able to meet social, economic and environmental targets in both local and global contexts. These include original solutions to the problems of pollution and congestion, vehicle and public safety, sustainable vehicle design and manufacture, new structures and materials, new power-train technologies and vehicle concepts. In addition to vehicle technologies, the book is also concerned with the broader systemic issues such as sustainable supply chain systems, integrated logistics

and telematics, and end-of-life vehicle management. It captures selected peer reviewed papers accepted for presentation at the 4th International Conference on Sustainable Automotive Technologies, ICSAT2012, held at the RMIT, Melbourne, Australia.

**Multidisciplinary Design Optimization Methods for Electrical Machines and Drive Systems** Gang Lei 2016-02-05

This book presents various computationally efficient component- and system-level design optimization methods for advanced electrical machines and drive systems. Readers will discover novel design optimization concepts developed by the authors and other researchers in the last decade, including application-oriented, multi-disciplinary, multi-objective, multi-level, deterministic, and robust design optimization methods. A multi-disciplinary analysis includes various aspects of materials,

electromagnetics, thermotics, mechanics, power electronics, applied mathematics, manufacturing technology, and quality control and management. This book will benefit both researchers and engineers in the field of motor and drive design and manufacturing, thus enabling the effective development of the high-quality production of innovative, high-performance drive systems for challenging applications, such as green energy systems and electric vehicles.

*Novel Motor Drive Design for a Switched Reluctance Machine Based Electric Vehicle Propulsion System*  
Peng Zhang 2010

Control Strategies of Permanent Magnet Synchronous Motor Drive for Electric Vehicle CHIRANJIT. SAIN  
2021-12-09 This book demonstrates the development of various control strategies and illustration of dynamic performance intensification of a Permanent Magnet Synchronous

Motor (PMSM) drive. Performance of a PMSM drive and control strategies executed through mathematical modelling is also discussed including case studies.

Design, Analysis and Application of Brushless Doubly Salient Machines

Ying Fan 2017-01-27 This dissertation, "Design, Analysis and Application of Brushless Doubly Salient Machines" by Ying, Fan, [?], was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Abstract of thesis entitled "Design, Analysis and Application of Brushless Doubly Salient Machines" submitted by FAN

Ying for the degree of Doctor of Philosophy at The University of Hong Kong in April 2006 In response to increasing concern about the environment, research into the development of electric vehicles (EVs) has accelerated in recent years. To enable electric vehicles to compete successfully with gasoline vehicles, the goals of motor drive for electric vehicles are to pursue optimal efficiency over wide operating ranges, high controllability, wide speed range, high reliability and maintenance-free operation. In order to pursue these goals, a new class of motor drives is proposed which consists of two types of stator windings, namely the poly-phase armature winding and dc field winding. This thesis presents the design, analysis and control of this brushless doubly-fed doubly-salient (BDFDS) motor drive. As a result of the search for alternative forms of energy, there has also been much

interest in the development of wind power generation. The core element of wind power generation is the electric generator. This thesis first presents a new three-phase 12/8-pole DSPM machine for wind power generation, including its design, analysis and implementation. The corresponding analysis of topological selection is specially elaborated. A three-phase 12/8-pole BDFDS machine is then developed for wind power generation, which uniquely offers constant output voltage and efficiency optimization over a wide range of wind speeds. The finite element method (FEM) has been used for electromagnetic field analysis of the proposed BDFDS machines, in which magnetic saturation, armature field and dc exciting field have been considered. Hence, the static characteristics, being the basis of analysis, design and control of the BDFDS machine, have been deduced. The sizing equation of the BDFDS machine has

been deduced and design details have been presented to provide a practical way of making initial calculation of machine dimensions and parameters. A dynamic model of the BDFDS machine has also been derived. Numerical simulation been carried out by using Matlab/Simulink revealed that the proposed three-phase BDFDS machine has the advantage of wide constant power operation range. The control strategies of two BDFDS machines, with skewed and unskewed rotors, have been developed and implemented by a dSPACE-based controller. Sinusoidal current control is used for the BDFDS machine with skewed rotor, whereas square current control is applied to the one with unskewed rotor. Moreover, a half-bridge power converter, which is composed of three IGBT-based power modules, has been employed to provide bi-directional current operation. It has the advantages of reducing the number of power switches and providing

independent phase current control. In order to minimize the torque ripple of the four-phase 8/6-pole DSPM motor, a new two-phase operation mode is proposed and analyzed, in which sinusoidal current control is proposed. Theoretical analysis, computer simulation, and experimental results have verified that the operating torque ripple at the rated load can be reduced by about 14% when using the proposed two-phase operation mode. The results of the numerous experiments conducted not only verify the validity of the theoretical analysis but also illustrate the good performance of the newly proposed BDFDS machines for electric

**Linear Electric Machines, Drives, and MAGLEVs Handbook** Ion Boldea

2017-12-19 Based on author Ion Boldea's 40 years of experience and the latest research, Linear Electric Machines, Drives, and Maglevs Handbook provides a practical and

comprehensive resource on the steady improvement in this field. The book presents in-depth reviews of basic concepts and detailed explorations of complex subjects, including classifications and practical topologies, with sample results based on an up-to-date survey of the field. Packed with case studies, this state-of-the-art handbook covers topics such as modeling, steady state, and transients as well as control, design, and testing of linear machines and drives. It includes discussion of types and applications—from small compressors for refrigerators to MAGLEV transportation—of linear electric machines. Additional topics include low and high speed linear induction or synchronous motors, with and without PMs, with progressive or oscillatory linear motion, from topologies through modeling, design, dynamics, and control. With a breadth and depth of coverage not found in

currently available references, this book includes formulas and methods that make it an authoritative and comprehensive resource for use in R&D and testing of innovative solutions to new industrial challenges in linear electric motion/energy automatic control.

*Control of Multiphase Machines and Drives* Federico Barrero 2020-01-24

With the growing interest in electrical machines in recent times, the multiphase machine field has developed into a fascinating research area. Their intrinsic features (power splitting, better fault tolerance, or lower torque ripple) make them an appealing competitor to conventional three-phase machines. Multiphase electric drives have been recently used in applications where fault tolerance and continuous operation of the drive are required. However, the difficulties in extending the three-phase conventional current regulation and control structure to multiphase

systems still limit their broad applicability in industry solutions. The main objective of this book is to illustrate new advances, developments, and applications in the field of multiphase machines and drives, while exposing these advances, developments, and applications to the scientific community and industry.

Automotive Innovation Patrick Hossay  
2019-06-25 Automotive Innovation: The Science and Engineering behind Cutting-Edge Automotive Technology provides a survey of innovative automotive technologies in the auto industry. Automobiles are rapidly changing, and this text explores these trends. IC engines, transmissions, and chassis are being improved, and there are advances in digital control, manufacturing, and materials. New vehicles demonstrate improved performance, safety and efficiency factors; electric vehicles represent a green energy alternative,

while sensor technologies and computer processors redefine the nature of driving. The text explores these changes, the engineering and science behind them, and directions for the future.

*Electric Powertrain* John G. Hayes  
2018-02-05 The why, what and how of the electric vehicle powertrain Empowers engineering professionals and students with the knowledge and skills required to engineer electric vehicle powertrain architectures, energy storage systems, power electronics converters and electric drives. The modern electric powertrain is relatively new for the automotive industry, and engineers are challenged with designing affordable, efficient and high-performance electric powertrains as the industry undergoes a technological evolution. Co-authored by two electric vehicle (EV) engineers with decades of experience designing and putting into production

all of the powertrain technologies presented, this book provides readers with the hands-on knowledge, skills and expertise they need to rise to that challenge. This four-part practical guide provides a comprehensive review of battery, hybrid and fuel cell EV systems and the associated energy sources, power electronics, machines, and drives. The first part of the book begins with a historical overview of electromobility and the related environmental impacts motivating the development of the electric powertrain. Vehicular requirements for electromechanical propulsion are then presented. Battery electric vehicles (BEV), fuel cell electric vehicles (FCEV), and conventional and hybrid electric vehicles (HEV) are then described, contrasted and compared for vehicle propulsion. The second part of the book features in-depth analysis of the electric powertrain traction machines, with a

particular focus on the induction machine and the surface- and interior-permanent magnet ac machines. The brushed dc machine is also considered due to its ease of operation and understanding, and its historical place, especially as the traction machine on NASA's Mars rovers. The third part of the book features the theory and applications for the propulsion, charging, accessory, and auxiliary power electronics converters. Chapters are presented on isolated and non-isolated dc-dc converters, traction inverters, and battery charging. The fourth part presents the introductory and applied electromagnetism required as a foundation throughout the book.

- Introduces and holistically integrates the key EV powertrain technologies.
- Provides a comprehensive overview of existing and emerging automotive solutions.
- Provides experience-based expertise for vehicular and powertrain system

and sub-system level study, design, and optimization. • Presents many examples of powertrain technologies from leading manufacturers. • Discusses the dc traction machines of the Mars rovers, the ultimate EVs from NASA. • Investigates the environmental motivating factors and impacts of electromobility. • Presents a structured university teaching stream from introductory undergraduate to postgraduate. • Includes real-world problems and assignments of use to design engineers, researchers, and students alike. • Features a companion website with numerous references, problems, solutions, and practical assignments. • Includes introductory material throughout the book for the general scientific reader. • Contains essential reading for government regulators and policy makers.

Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell

Vehicles is an important professional resource for practitioners and researchers in the battery, hybrid, and fuel cell EV transportation industry. The book is a structured holistic textbook for the teaching of the fundamental theories and applications of energy sources, power electronics, and electric machines and drives to engineering undergraduate and postgraduate students. Textbook Structure and Suggested Teaching Curriculum This is primarily an engineering textbook covering the automotive powertrain, energy storage and energy conversion, power electronics, and electrical machines. A significant additional focus is placed on the engineering design, the energy for transportation, and the related environmental impacts. This textbook is an educational tool for practicing engineers and others, such as transportation policy planners and regulators. The modern automobile is

used as the vehicle upon which to base the theory and applications, which makes the book a useful educational reference for our industry colleagues, from chemists to engineers. This material is also written to be of interest to the general reader, who may have little or no interest in the power electronics and machines.

Introductory science, mathematics, and an inquiring mind suffice for some chapters. The general reader can read the introduction to each of the chapters and move to the next as soon as the material gets too advanced for him or her. Part I Vehicles and Energy Sources Chapter 1 Electromobility and the Environment Chapter 2 Vehicle Dynamics Chapter 3 Batteries Chapter 4 Fuel Cells Chapter 5 Conventional and Hybrid Powertrains Part II Electrical Machines Chapter 6 Introduction to Traction Machines Chapter 7 The Brushed DC Machine Chapter 8

Induction Machines Chapter 9 Surface-permanent-magnet AC Machines Chapter 10: Interior-permanent-magnet AC Machines Part III Power Electronics Chapter 11 DC-DC Converters Chapter 12 Isolated DC-DC Converters Chapter 13 Traction Drives and Three-phase Inverters Chapter 14 Battery Charging Chapter 15 Control of the Electric Drive Part IV Basics Chapter 16 Introduction to Electromagnetism, Ferromagnetism, and Electromechanical Energy Conversion The first third of the book (Chapters 1 to 6), plus parts of Chapters 14 and 16, can be taught to the general science or engineering student in the second or third year. It covers the introductory automotive material using basic concepts from mechanical, electrical, environmental, and electrochemical engineering. Chapter 14 on electrical charging and Chapter 16 on electromagnetism can also be used as a general introduction to electrical engineering. The basics of

electromagnetism, ferromagnetism and electromechanical energy conversion (Chapter 16) and dc machines (Chapter 7) can be taught to second year (sophomore) engineering students who have completed introductory electrical circuits and physics. The third year (junior) students typically have covered ac circuit analysis, and so they can cover ac machines, such as the induction machine (Chapter 8) and the surface permanent-magnet ac machine (Chapter 9). As the students typically have studied control theory, they can investigate the control of the speed and torque loops of the motor drive (Chapter 15). Power electronics, featuring non-isolated buck and boost converters (Chapter 11), can also be introduced in the third year. The final-year (senior) students can then go on to cover the more advanced technologies of the interior-permanent-magnet ac machine (Chapter 10). Isolated power converters

(Chapter 12), such as the full-bridge and resonant converters, inverters (Chapter 13), and power-factor-corrected battery chargers (Chapter 14), are covered in the power electronics section. This material can also be covered at the introductory postgraduate level. Various homework, simulation, and research exercises are presented throughout the textbook. The reader is encouraged to attempt these exercises as part of the learning experience. Instructors are encouraged to contact the author, John Hayes, direct to discuss course content or structure.

### **Advances in Smart Grid Technology**

Ning Zhou 2020-09-18 This book comprises the select proceedings of the International Conference on Power Engineering Computing and Control (PECCON) 2019. This volume covers several important topics such as optimal data selection and error-free data acquiring via artificial

intelligence and machine learning techniques, information and communication technologies for monitoring and control of smart grid components, and data security in smart grid network. In addition, it also focuses on economics of renewable electricity generation, policies for distributed generation, smart eco-structures and systems. This book can be useful for beginners, researchers as well as professionals interested in the area of smart grid technology.

**Electric Machines for Smart Grids Applications** Adel El-Shahat

2018-12-12 In this book, highly qualified scientists present their recent research motivated by the importance of electric machines. It addresses advanced studies for high-speed electrical machine design, mechanical design of rotors with surface-mounted permanent magnets, design of motor drive for brushless DC motor, single-phase motors for

household applications, battery electric propulsion systems for competition racing applications, robust diagnosis by observer using the bond graph approach, a DC motor simulator based on virtual instrumentation, start-up of a PID fuzzy logic embedded control system for the speed of a DC motor using LabVIEW, advanced control of the permanent magnet synchronous motor and optimization of fuzzy logic controllers by particle swarm optimization to increase the lifetime in power electronic stages.

**Design, Analysis and Operation of IPMSMs for HEV Applications** Abdul Rehman Tariq 2010

*Electric Vehicle Machines and Drives: Design, Analysis and Application* K. T. Chau 2015-08-24 It provides a comprehensive coverage of electric machines and drives for electric and hybrid vehicles, including both electric propulsion and hybrid propulsion. The corresponding motor

drives for electric propulsion range from the existing types, namely the DC, induction, permanent magnet brushless and switched reluctance motor drives, to the advanced types, namely the doubly salient permanent magnet, magnetic-gear, vernier permanent magnet and advanced magnetless motor drives. The corresponding machine systems for hybrid propulsion cover the existing types, namely the integrated starter generator and planetary-gear electric variable transmission systems, and the advanced types, namely the double-rotor electric variable transmission and magnetic-gear electric variable transmission systems. Emphasis is given to the design criteria, performance analyses and application examples or potentials of various motor drives and machine systems.

Hybrid Electric Power Train Engineering and Technology: Modeling, Control, and Simulation Szumanowski,

*electric-vehicle-machines-and-drives-design-analysis-and-application*

Antoni 2013-05-31 Hybridization is an increasingly popular paradigm in the auto industry, but one that is not fully understood by car manufacturers. In general, hybrid electric vehicles (HEV) are designed without regard to the mechanics of the power train, which is developed similarly to its counterparts in internal combustion engines. Hybrid Electric Power Train Engineering and Technology: Modeling, Control, and Simulation provides readers with an academic investigation into HEV power train design using mathematical modeling and simulation of various hybrid electric motors and control systems. This book explores the construction of the most energy efficient power trains, which is of importance to designers, manufacturers, and students of mechanical engineering. This book is part of the Research Essentials collection.

**Electric and Hybrid Vehicles** Iqbal

Downloaded from [weightism.org](http://weightism.org) on July 5, 2022 by guest

Husain 2021-02-22 A thoroughly revised third edition of this widely praised, bestselling textbook presents a comprehensive systems-level perspective of electric and hybrid vehicles with emphasis on technical aspects, mathematical relationships and basic design guidelines. The emerging technologies of electric vehicles require the dedication of current and future engineers, so the target audience for the book is the young professionals and students in engineering eager to learn about the area. The book is concise and clear, its mathematics are kept to a necessary minimum and it contains a well-balanced set of contents of the complex technology. Engineers of multiple disciplines can either get a broader overview or explore in depth a particular aspect of electric or hybrid vehicles. Additions in the third edition include simulation-based design analysis of electric and hybrid

vehicles and their powertrain components, particularly that of traction inverters, electric machines and motor drives. The technology trends to incorporate wide bandgap power electronics and reduced rare-earth permanent magnet electric machines in the powertrain components have been highlighted. Charging stations are a critical component for the electric vehicle infrastructure, and hence, a chapter on vehicle interactions with the power grid has been added. Autonomous driving is another emerging technology, and a chapter is included describing the autonomous driving system architecture and the hardware and software needs for such systems. The platform has been set in this book for system-level simulations to develop models using various softwares used in academia and industry, such as MATLAB®/Simulink, PLECS, PSIM, Motor-CAD and Altair Flux. Examples and simulation results

are provided in this edition using these software tools. The third edition is a timely revision and contribution to the field of electric vehicles that has reached recently notable markets in a more and more environmentally sensitive world.

*Standard Handbook for Electrical Engineers, Seventeenth Edition* Surya Santoso 2017-11-24 Up-to-date coverage of every facet of electric power in a single volume This fully revised, industry-standard resource offers practical details on every aspect of electric power engineering. The book contains in-depth discussions from more than 100 internationally recognized experts. Generation, transmission, distribution, operation, system protection, and switchgear are thoroughly explained. *Standard Handbook for Electrical Engineers, Seventeenth Edition*, features brand-new sections on measurement and instrumentation, interconnected power

grids, smart grids and microgrids, wind power, solar and photovoltaic power generation, electric machines and transformers, power system analysis, operations, stability and protection, and the electricity market. Coverage includes:

- Units, symbols, constants, definitions, and conversion factors
- Measurement and instrumentation
- Properties of materials
- Interconnected power grids
- AC and DC power transmission
- Power distribution
- Smart grids and microgrids
- Wind power generation
- Solar power generation and energy storage
- Substations and switch gear
- Power transformers, generators, motors, and drives
- Power electronics
- Power system analysis, operations, stability, and protection
- Electricity markets
- Power quality and reliability
- Lightning and overvoltage protection
- Computer applications in the electric power industry
- Standards in electrotechnology,

telecommunications, and IT  
*Electric Machines* Ion Boldea  
2021-10-08 This Second Edition  
extensively covers advanced  
issues/subjects in electric machines,  
starting from principles, to  
applications and case studies with  
ample graphical (numerical) results.  
This textbook is intended for second  
(and third) semester courses covering  
topics such as modeling of  
transients, control principles,  
electromagnetic and thermal finite  
element analysis, and optimal design  
(dimensioning). Notable recent  
knowledge with strong  
industrialization potential has been  
added to this edition, such as:  
Orthogonal models of multiphase a.c.  
machines Thermal Finite Element  
Analysis of (FEA) electric machines  
FEA-based-only optimal design of a PM  
motor case study Line start  
synchronizing premium efficiency PM  
induction machines Induction machines  
(three and single phase), synchronous

machines with DC excitation, with PM-  
excitation, and with magnetically  
salient rotor and a linear Pm  
oscillatory motor are all  
investigated in terms of transients,  
electromagnetic FEM analysis and  
control principles. Case studies,  
numerical examples, and lots of  
discussion of FEM results for PMSM  
and IM are included throughout the  
book. The optimal design is treated  
in detail using Hooke-Jeeves and GA  
algorithms with case comparison  
studies in dedicated chapters for IM  
and PMSM. Numerous computer  
simulation programs in MATLAB® and  
Simulink® are available online that  
illustrate performance  
characteristics present in the  
chapters, and the FEM and optimal  
design case studies (and codes) may  
be used as homework to facilitate a  
deeper understanding of fundamental  
issues.

**Modern Electric, Hybrid Electric, and  
Fuel Cell Vehicles, Third Edition**

Downloaded from [weightism.org](http://weightism.org) on July  
5, 2022 by guest

Mehrdad Ehsani 2018-02-02 The book deals with the fundamentals, theoretical bases, and design methodologies of conventional internal combustion engine (ICE) vehicles, electric vehicles (EVs), hybrid electric vehicles (HEVs), and fuel cell vehicles (FCVs). The design methodology is described in mathematical terms, step-by-step, and the topics are approached from the overall drive train system, not just individual components. Furthermore, in explaining the design methodology of each drive train, design examples are presented with simulation results.

#### New Trends in Electrical Vehicle

Powertrains Luis Romeral Martinez 2019-01-30 The electric vehicle and plug-in hybrid electric vehicle play a fundamental role in the forthcoming new paradigms of mobility and energy models. The electrification of the

transport sector would lead to advantages in terms of energy efficiency and reduction of greenhouse gas emissions, but would also be a great opportunity for the introduction of renewable sources in the electricity sector. The chapters in this book show a diversity of current and new developments in the electrification of the transport sector seen from the electric vehicle point of view: first, the related technologies with design, control and supervision, second, the powertrain electric motor efficiency and reliability and, third, the deployment issues regarding renewable sources integration and charging facilities. This is precisely the purpose of this book, that is, to contribute to the literature about current research and development activities related to new trends in electric vehicle power trains.