

# Electric Vehicle Machines And Drives Design Analysis And Application

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*Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) Technologies* Sekyung Han 2021-03-16 This Special Issue "Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) Technologies" was in session from 1 May 2019 to 31 May 2020. For this Special issue, we invited articles on current state-of-the-art technologies and solutions in G2V and V2G, including but not limited to the operation and control of gridable vehicles, energy storage and management systems, charging infrastructure and chargers, EV demand and load forecasting, V2G interfaces and applications, V2G and energy reliability and security, environmental impacts, and economic benefits as well as demonstration projects and case studies in the aforementioned areas. Articles that deal with the latest hot topics in V2G are of particular interest, such as V2G and demand-side response control technique, smart charging infrastructure and grid planning, advanced power electronics for V2G systems, adaptation of V2G systems in the smart grid, adaptation of smart cities for a large number of EVs, integration, and the optimization of V2G systems, utilities and transportation assets

for advanced V2G systems, wireless power transfer systems for advanced V2G systems, fault detection, maintenance and diagnostics in V2G processes, communications protocols for V2G systems, energy management system (EMS) in V2G systems, IoT for V2G systems, distributed energy and storage systems for V2G, transportation networks and V2G, energy management for V2G, smart charging/discharging stations for efficient V2G, environmental and socio-economic benefits and challenges of V2G systems, and building integrated V2G systems (BIV2G). Five manuscripts are published in this Special Issue, including "An Ensemble Stochastic Forecasting Framework for Variable Distributed Demand Loads" by Agyeman et al., "Where Will You Park? Predicting Vehicle Locations for Vehicle-to-Grid, An MPC Scheme with Enhanced Active Voltage Vector Region for V2G Inverter" by Shipman et al., "Electric Vehicles Energy Management with V2G/G2V Multifactor Optimization of Smart Grids" by Xia et al., and "A Review on Communication Standards and Charging Topologies of V2G and V2H Operation Strategies" by Savitti et al.

**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

### **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.

*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.

### **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.

### 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.

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

**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.

**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.

*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.

**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.

*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.

### **Alternative Fuels and Advanced Vehicle Technologies for**

### **Improved Environmental Performance** Richard Folkson 2022-07-29

Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance: Towards Zero Carbon Transportation, Second Edition provides a comprehensive view of key developments in advanced fuels and vehicle technologies to improve the energy efficiency and environmental impact of the automotive sector. Sections consider the role of alternative fuels such as electricity, alcohol and hydrogen fuel cells, as well as advanced additives and oils in environmentally sustainable transport. Other topics explored include methods of revising engine and vehicle design to improve environmental performance and fuel economy and developments in electric and hybrid vehicle technologies. This reference will provide professionals, engineers and researchers of alternative fuels with an understanding of the latest clean technologies which will help them to advance the field. Those working in environmental and mechanical engineering will benefit from the detailed analysis of the technologies covered, as will fuel suppliers and energy producers seeking to improve the efficiency, sustainability and accessibility of their work. Provides a fully updated reference with significant technological advances and developments in the sector Presents analyses on the latest advances in electronic systems for emissions control, autonomous systems, artificial intelligence and legislative requirements Includes a strong focus on updated climate change predictions and consequences, helping the reader work towards ambitious 2050 climate change goals for the automotive industry

**Switched Reluctance Motor Drives** Babak Fahimi 2017 "This book gives readers crucial information to understand magnetic design, dynamic modeling, and high-grade control of switched reluctance motor drives (SRM) in the context of various motoring and generation applications. That includes those required in automotive, consumer

products, and energy-harvesting industries. Content covers experimental and application-related design strategies and provides insightful explanations of multi-physics problems within SRM. It opens the door for new opportunities to use SRM drives in other relevant industries, especially those aimed at operation under harsh environmental conditions and very high speeds."--Provided by publisher.

**Graph-Based Modelling in Science, Technology and Art** Stanisław Zawiślak 2021-09-02 This book presents interdisciplinary, cutting-edge and creative applications of graph theory and modeling in science, technology, architecture and art. Topics are divided into three parts: the first one examines mechanical problems related to gears, planetary gears and engineering installations; the second one explores graph-based methods applied to medical analyses as well as biological and chemical modeling; and the third part includes various topics e.g. drama analysis, aiding of design activities and network visualisation. The authors represent several countries in Europe and America, and their contributions show how different, useful and fruitful the utilization of graphs in modelling of engineering systems can be. The book has been designed to serve readers interested in the subject of graph modelling and those with expertise in related areas, as well as members of the worldwide community of graph modelers.

**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.

**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

### **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, 方莹, 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 Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Third Edition 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. *Proceedings of the ... International Electric Vehicle Symposium* 1992

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

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.

*Electric Vehicle Technology Explained* James Larminie 2012-09-17

**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 Machines and Drives Ned Mohan 2012-01-03 Mohan's Electric Machines and Drives is part of a three-book series designed for the power sequence electives on Electrical Engineering. The book focuses on power topics including advances in hybrid-electric cars and alternative

energy systems, coupled with severe environmental problems associated with hydrocarbon-based fuels. The text builds off Mohan's successful MNPERE titles and adopts a systems approach.

**PM Motor Parametric Design Analyses for Hybrid Electric Vehicle Traction Drive Application** R. H. Staunton 2004

The Department of Energy's (DOE) Office of FreedomCAR (Cooperative Automotive Research) and Vehicle Technologies has a strong interest in making rapid progress in permanent magnet (PM) machine development. The program is directing various technology development projects that will advance the technology and lead to request for proposals (RFP) for manufacturer prototypes. This aggressive approach is possible because the technology is clearly within reach and the approach is deemed essential, based on strong market demand, escalating fuel prices, and competitive considerations. In response, this study began parallel development paths that included a literature search/review, development and utilization of multiple parametric models to determine the effects of design parameters, verification of the modeling methodology, development of an interior PM (IPM) machine baseline design, development of alternative machine baseline designs, and cost analyses for several candidate machines. This interim progress report summarizes the results of these activities as of June 2004. This report provides background and summary information for recent machine parametric studies and testing programs that demonstrate both the potential capabilities and technical limitations of brushless PM machines (axial gap and radial gap), the IPM machine, the surface-mount PM machines (interior or exterior rotor), induction machines, and switched reluctance machines. The FreedomCAR program, while acknowledging the progress made by Oak Ridge National Laboratory, Delphi, Delco-Remy International, and others in these programs, has redirected efforts toward a "short path" to a marketable and competitive PM motor for hybrid electric vehicle traction applications. The program has developed a set of performance targets for the type of traction machine desired. The short-path approach entails a comprehensive design effort focusing on the IPM machine and meeting the performance targets. The selection

of the IPM machine reflects industry's confidence in this market-proven design that exhibits a power density surpassed by no other machine design.

**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.

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.

*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.

Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles  
Chitra A. 2020-07-10 Electric vehicles/hybrid electric vehicles (EV/HEV) commercialization is still a challenge in industries in terms of performance and cost. The performance along with cost reduction are two tradeoffs which need to be researched to arrive at an optimal solution. This book focuses on the convergence of various technologies involved in EV/HEV. The book brings together the research that is being carried out in the field of EV/HEV whose leading role is by optimization techniques with artificial intelligence (AI). Other featured research includes green drive schemes which involve the possible renewable energy sources integration to develop eco-friendly green vehicles, as well as Internet of Things (IoT)-based techniques for EV/HEVs. Electric vehicle research involves multi-disciplinary expertise from electrical, electronics, mechanical engineering and computer science. Consequently, this book serves as a point of convergence wherein all these domains are addressed and merged and will serve as a potential resource for industrialists and researchers working in the domain of electric vehicles.

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.

**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.

**PM Motor Parametric Design Analyses for a Hybrid Electric Vehicle Traction Drive Application** R. H. Staunton 2004 The Department of Energy's (DOE) Office of FreedomCAR (Cooperative Automotive Research) and Vehicle Technologies office has a strong interest in making rapid progress in permanent magnet (PM) machine development. The DOE FreedomCAR program is directing various technology development projects that will advance the technology and hopefully lead to a near-term request for proposals (RFP) for a to-be-determined level of initial production. This aggressive approach is possible because the technology is clearly within reach and the approach is deemed essential, based on strong market demand, escalating fuel prices, and competitive considerations. In response, this study began parallel development paths that included a literature search/review, development and utilization of multiple parametric models, verification of the modeling methodology, development of an interior PM (IPM) machine baseline design, development of alternative machine baseline

designs, and cost analyses for several candidate machines. This report summarizes the results of these activities as of September 2004. This report provides background and summary information for recent machine parametric studies and testing programs that demonstrate both the potential capabilities and technical limitations of brushless PM machines (axial gap and radial gap), the IPM machine, the surface-mount PM machines (interior or exterior rotor), induction machines, and switched-reluctance machines. The FreedomCAR program, while acknowledging the progress made by Oak Ridge National Laboratory (ORNL), Delphi, Delco-Remy International, and others in these programs, has redirected efforts toward a "short path" to a marketable and competitive PM motor for hybrid electric vehicle (HEV) traction applications. The program has developed a set of performance targets for the type of traction machine desired. The short-path approach entails a comprehensive design effort focusing on the IPM machine and meeting the performance targets. The selection of the IPM machine reflects industry's confidence in this market-proven design that exhibits a high power density.

**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

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

*The Bhutan Electric Vehicle Initiative* Da Zhu 2016-04-06 As the country that inspires the world with 'gross national happiness' development philosophy, Bhutan is striving to pursue its economic growth while committing to its core values of inclusive and green development. Even with robust economic growth rates, Bhutan's dependence on imports and hydropower revenues drives the country to search for self-reliant option to fuel the economy while further decarbonizing the economy. Electric vehicle is being explored as one of the key policies to introduce green mobility, reduce fossil fuel imports and put the country firmly on a green growth path. Globally, electric vehicles market and technology are still in the nascent stage but are developing rapidly. The automotive industry has adopted electrification as a pillar of future drive train technology. EV uptake is expected to increase significantly with ongoing improvements

in technology and resulting cost decreases in the global market. This report aims to help Bhutan think through various technical and policy issues of introducing electric vehicles in its own context. It analyses a variety of factors that will impact adoption of electric vehicles from technical, market and financial feasibility to consumer awareness and stakeholders' capacity. It also addresses several policy questions which are at the heart of public debate such as affordability of the government to undertake the program, economic costs and benefits, distributional impact, fiscal, and macroeconomic implications. Drawing from vast international experiences, the report examines in great technical details how global cutting-edge technology like electric vehicles could be pursued in the context of developing economies with different socio-economic characteristics and constraints compared to advanced economies. It will help readers better grasp the technical, financial, economic and social challenges as well as opportunities in initiating electric vehicles program and provide practical recommendations that will be useful for policy makers in designing their own EV initiative.

**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.

### **Power Electronics and Electric Drives for Traction Applications**

Gonzalo Abad 2016-11-14 Power Electronics and Electric Drives for Traction Applications offers a practical approach to understanding power electronics applications in transportation systems ranging from railways to electric vehicles and ships. It is an application-oriented book for the design and development of traction systems accompanied by a description of the core technology. The first four introductory chapters describe the common knowledge and background required to understand the preceding chapters. After that, each application-specific chapter: highlights the significant manufacturers involved; provides a historical account of the technological evolution experienced; distinguishes the physics and mechanics; and where possible, analyses a real life example and provides the necessary models and simulation tools, block diagrams and simulation based validations. Key features: Surveys power electronics state-of-the-art in all aspects of traction applications. Presents vital design and development knowledge that is extremely important for the professional community in an original, simple, clear and complete manner. Offers design guidelines for power electronics traction systems in high-speed rail, ships, electric/hybrid vehicles, elevators and more applications. Application-specific chapters co-

authored by traction industry expert. Learning supplemented by tutorial sections, case studies and MATLAB/Simulink-based simulations with data from practical systems. A valuable reference for application engineers in traction industry responsible for design and development of products as well as traction industry researchers, developers and graduate students on power electronics and motor drives needing a reference to the application examples.

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.

**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.