

Power Converters And Ac Electrical Drives With Linear Neural Networks Energy Power Electronics And Machines

Today, there is a great deal of attention focused on sustainable growth worldwide. The increase in efficiency in the use of energy may even, in this historical moment, bring greater benefit than the use of renewable energies. Electricity appears to be the most sustainable of energies and the most promising hope for a planet capable of growing without compromising its own health and that of its inhabitants. Power electronics and electrical drives are the key technologies that will allow energy savings through the reduction of energy losses in many applications. This Special Issue has collected several scientific contributions related to energy efficiency in electrical equipment. Some articles are dedicated to the use and optimization of permanent magnet motors, which allow obtaining the highest level of efficiency. Most of the contributions describe the energy improvements that can be achieved with power electronics and the use of suitable control techniques. Last but not least, some articles describe interesting solutions for hybrid vehicles, which were created mainly to save energy in the smartest way possible.

This book covers power electronics, in depth, by presenting the basic principles and application details, which can be used both as a textbook and reference book. Introduces a new method to present power electronics converters called Power Blocks Geometry (PBG) Applicable for courses focusing on power electronics, power electronics converters, and advanced power converters Offers a comprehensive set

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of simulation results to help understand the circuits presented throughout the book

The complexity of AC motor control lies in the multivariable and nonlinear nature of AC machine dynamics. Recent advancements in control theory now make it possible to deal with long-standing problems in AC motors control. This text expertly draws on these developments to apply a wide range of model-based control design methods to a variety of AC motors. Contributions from over thirty top researchers explain how modern control design methods can be used to achieve tight speed regulation, optimal energetic efficiency, and operation reliability and safety, by considering online state variable estimation in the absence of mechanical sensors, power factor correction, machine flux optimization, fault detection and isolation, and fault tolerant control. Describing the complete control approach, both controller and observer designs are demonstrated using advanced nonlinear methods, stability and performance are analysed using powerful techniques, including implementation considerations using digital computing means. Other key features:

- Covers the main types of AC motors including triphase, multiphase, and doubly fed induction motors, wound rotor, permanent magnet, and interior PM synchronous motors
- Illustrates the usefulness of the advanced control methods via industrial applications including electric vehicles, high speed trains, steel mills, and more
- Includes special focus on sensorless nonlinear observers, adaptive and robust nonlinear controllers, output-feedback controllers, fault detection and isolation algorithms, and fault tolerant controllers

This comprehensive volume provides researchers and designers and R&D engineers with a single-source reference on AC motor system drives in the automotive and transportation industry. It will also appeal to advanced students in automatic control, electrical, power systems, mechanical engineering

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and robotics, as well as mechatronic, process, and applied control system engineers.

Electrical drives play an important role as electromechanical energy converters in transportation, material handling and most production processes. The ease of controlling electrical drives is an important aspect for meeting the increasing demands by the user with respect to flexibility and precision, caused by technological progress in industry as well as the need for energy conservation. At the same time, the control of electrical drives has provided strong incentives to control engineering in general, leading to the development of new control structures and their introduction to other areas of control. This is due to the stringent operating conditions and widely varying specifications - a drive may alternately require control of torque, acceleration, speed or position - and the fact that most electric drives have - in contrast to chemical or thermal processes - well defined structures and consistent dynamic characteristics. During the last years the field of controlled electrical drives has undergone rapid expansion due mainly to the advances of semiconductors in the form of power electronics as well as analogue and digital signal electronics, eventually culminating in microelectronics and microprocessors. The introduction of electronically switched solid-state power converters has renewed the search for adjustable speed AC motor drives, not subject to the limitations of the mechanical commutator of DC drives which dominated the field for a century.

This is the final volume in a four-volume series concerning POWER ELECTRONIC CONVERTERS. The first volume studies AC/DC conversion, the second studies AC/AC conversion, and the third DC/DC conversion. This final volume deals with DC/AC conversion, i.e. with inverters. At the output of an inverter fed by a DC voltage supply, this voltage is alternatively found with one polarity and then with

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the other; in other words, an AC voltage made up of square pulses is obtained. Filtering must be carried out if, as is normally the case, a virtually sinusoidal voltage is required: this problem of filtering underlies the entire study of inverters. In some applications, the load itself provides the filtering. In others, a filter is installed between the inverter and the load; however, as it will be shown in Chap. 2, in cases where the filtered voltage is at industrial network frequency and comprises only a single square-wave pulse per half-cycle, the filter becomes bulky and costly, and the results obtained are poor. Filtering problems explain the considerable development of inverters during the last years: - Firstly there is increasing use of pulse width modulation: each half-cycle is cut up into several pulses of suitable widths; this greatly simplifies filtering. The use of a chopping frequency which is much greater than the frequency of the fundamental components of the inverter output voltage and current has only been made possible by progress in the field of semiconductor devices.

An examination of all of the multidisciplinary aspects of medium- and high-power converter systems, including basic power electronics, digital control and hardware, sensors, analog preprocessing of signals, protection devices and fault management, and pulse-width-modulation (PWM) algorithms, *Switching Power Converters: Medium and High Power, Second Edition* discusses the actual use of industrial technology and its related subassemblies and components, covering facets of implementation otherwise overlooked by theoretical textbooks. The updated Second Edition contains many new figures, as well as new and/or improved chapters on: Thermal management and reliability Intelligent power modules AC/DC and DC/AC current source converters Multilevel converters Use of IPM within a "network of switches" concept Power semiconductors Matrix converters

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Practical aspects in building power converters Providing the latest research and development information, along with numerous examples of successful home appliance, aviation, naval, automotive electronics, industrial motor drive, and grid interface for renewable energy products, this edition highlights advancements in packaging technologies, tackles the advent of hybrid circuits able to incorporate control and power stages within the same package, and examines design for reliability from the system level perspective.

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* The first single volume resource for researchers in the field who previously had to depend on separate papers and conference records to attain a working knowledge of the subject. * Brings together the field's diverse approaches into an integrated and comprehensive theory of PWM

Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles acquaints professionals with trends and challenges in the development of more electric vehicles (MEVs) using detailed examples and comprehensive discussions of advanced MEV power system architectures, characteristics, and dynamics. The authors focus on real-world applications and highlight issues related to system stability as well as challenges faced during and after implementation. Probes innovations in the development of more electric vehicles for improved maintenance, support, endurance, safety, and cost-efficiency in automotive, aerospace, and marine vehicle engineering Heralding a new wave of advances in power system technology, Vehicular Electric Power Systems discusses: Different automotive power systems including conventional automobiles, more electric cars, heavy-duty vehicles, and electric and hybrid electric vehicles Electric and hybrid electric propulsion systems and control strategies Aerospace power systems including conventional and

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advanced aircraft, spacecraft, and the international space station Sea and undersea vehicles The modeling, real-time state estimation, and stability assessment of vehicular power systems Applications of fuel cells in various land, sea, air, and space vehicles Modeling techniques for energy storage devices including batteries, fuel cells, photovoltaic cells, and ultracapacitors Advanced power electronic converters and electric motor drives for vehicular applications Guidelines for the proper design of DC and AC distribution architectures Presents Fundamentals of Modeling, Analysis, and Control of Electric Power Converters for Power System Applications Electronic (static) power conversion has gained widespread acceptance in power systems applications; electronic power converters are increasingly employed for power conversion and conditioning, compensation, and active filtering. This book presents the fundamentals for analysis and control of a specific class of high-power electronic converters—the three-phase voltage-sourced converter (VSC). Voltage-Sourced Converters in Power Systems provides a necessary and unprecedented link between the principles of operation and the applications of voltage-sourced converters. The book: Describes various functions that the VSC can perform in electric power systems Covers a wide range of applications of the VSC in electric power systems—including wind power conversion systems Adopts a systematic approach to the modeling and control design problems Illustrates the control design procedures and expected performance based on a comprehensive set of examples and digital computer time-domain simulation studies This comprehensive text presents effective techniques for mathematical modeling and control design, and helps readers understand the procedures and analysis steps. Detailed simulation case studies are included to highlight the salient points and verify the designs. Voltage-Sourced Converters in Power Systems is an ideal reference

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for senior undergraduate and graduate students in power engineering programs, practicing engineers who deal with grid integration and operation of distributed energy resource units, design engineers, and researchers in the area of electric power generation, transmission, distribution, and utilization.

This contributed volume is written by key specialists working in multidisciplinary fields in electrical engineering, linking control theory, power electronics, artificial neural networks, embedded controllers and signal processing. The authors of each chapter report the state of the art of the various topics addressed and present results of their own research, laboratory experiments and successful applications. The presented solutions concentrate on three main areas of interest: · motion control in complex electromechanical systems, including sensorless control; · fault diagnosis and fault tolerant control of electric drives; · new control algorithms for power electronics converters. The chapters and the complete book possess strong monograph attributes.

Important practical and theoretical problems are deeply and accurately presented on the background of an exhaustive state-of-the-art review. Many results are completely new and were never published before. Well-known control methods like field oriented control (FOC) or direct torque control (DTC) are referred as a starting point for modifications or are used for comparison. Among numerous control theories used to solve particular problems are: nonlinear control, robust control, adaptive control, Lyapunov techniques, observer design, model predictive control, neural control, sliding mode control, signal filtration and processing, fault diagnosis, and fault tolerant control.

A timely introduction to current research on PID and predictive control by one of the leading authors on the subject
PID and Predictive Control of Electric Drives and Power

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Supplies using MATLAB/Simulink examines the classical control system strategies, such as PID control, feed-forward control and cascade control, which are widely used in current practice. The authors share their experiences in actual design and implementation of the control systems on laboratory test-beds, taking the reader from the fundamentals through to more sophisticated design and analysis. The book contains sections on closed-loop performance analysis in both frequency domain and time domain, presented to help the designer in selection of controller parameters and validation of the control system. Continuous-time model predictive control systems are designed for the drives and power supplies, and operational constraints are imposed in the design. Discrete-time model predictive control systems are designed based on the discretization of the physical models, which will appeal to readers who are more familiar with sampled-data control system. Soft sensors and observers will be discussed for low cost implementation. Resonant control of the electric drives and power supply will be discussed to deal with the problems of bias in sensors and unbalanced three phase AC currents. Brings together both classical control systems and predictive control systems in a logical style from introductory through to advanced levels. Demonstrates how simulation and experimental results are used to support theoretical analysis and the proposed design algorithms. MATLAB and Simulink tutorials are given in each chapter to show the readers how to take the theory to applications. Includes MATLAB and Simulink software using xPC Target for teaching purposes. A companion website is available. Researchers and industrial engineers; and graduate students on electrical engineering courses will find this a valuable resource.

This thesis proposes new power converter topologies suitable for aircraft systems. It also proposes both AC-DC and DC-DC

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types of converters for different electrical loads to improve the performance these systems. To increase fuel efficiency and reduce environmental impacts, less efficient non-electrical aircraft systems are being replaced by electrical systems. However, more electrical systems requires more electrical power to be generated in the aircraft. The increased consumption of electrical power in both civil and military aircrafts has necessitated the use of more efficient electrical power conversion technologies. This book presents a comprehensive mathematical analysis and the design and digital simulation of the power converters. Subsequently it discusses the construction of the hardware prototypes of each converter and the experimental tests carried out to verify the benefits of the proposed solutions in comparison to the existing solutions.

Power Converters for Electric Vehicles gives an overview, topology, design, and simulation of different types of converters used in electric vehicles (EV). It covers a wide range of topics ranging from the fundamentals of EV, Hybrid EV and its stepwise approach, simulation of the proposed converters for real-time applications and corresponding experimental results, performance improvement paradigms, and overall analysis. Drawing upon the need for novel converter topologies, this book provides the complete solution for the power converters for EV applications along with simulation exercises and experimental results. It explains the need for power electronics in the improvement of performance in EV. This book: Presents exclusive information on the power electronics of EV including traction drives. Provides step-by-step procedure for converter design. Discusses various topologies having different isolated and non-isolated converters. Describes control circuit design including renewable energy systems and electrical drives. Includes practical case studies incorporated with simulation

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and experimental results. Power Converters for Electric Vehicles will provide researchers and graduate students in Power Electronics, Electric Drives, Vehicle Engineering a useful resource for stimulating their efforts in this important field of the search for renewable technologies.

AC voltage frequency changes is one of the most important functions of solid state power converters. The most desirable features in frequency converters are the ability to generate load voltages with arbitrary amplitude and frequency, sinusoidal currents and voltages waveforms; the possibility of providing unity power factor for any load; and, finally, a simple and compact power circuit. Over the past decades, a number of different frequency converter topologies have appeared in the literature, but only the converters with either a voltage or current DC link are commonly used in industrial applications. Improvements in power semiconductor switches over recent years have resulted in the development of many structures of AC-AC converters without DC electric energy storage. Such converters are an alternative solution for frequently recommended systems with DC energy storage and are characterized by a lower price, smaller size and longer lifetime. Most of the these topologies are based on the structure of the matrix converter. Three-Phase AC-AC Power Converters Based On Matrix Converter Topology: Matrix-reactance frequency converters concept presents a review of power frequency converters, with special attention paid to converters without DC energy storage. Particular attention is paid to nine new converters named matrix-reactance frequency converters which have been developed by the author and the team of researchers from Institute of Electrical Engineering at the University of Zielona Góra. The topologies of the presented matrix-reactance frequency converters are based on a three-phase unipolar buck-boost matrix-reactance chopper with source or load switches arranged as in a matrix

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converter. This kind of approach makes it possible to obtain an output voltage greater than the input one (similar to that in a matrix-reactance chopper) and a frequency conversion (similar to that in a matrix converter). Written for researchers and Ph.D. students working in the field of power electronics converters and drive systems, *Three-Phase AC-AC Power Converters Based On Matrix Converter Topology: Matrix-reactance frequency converters* concept will also be valuable to power electronics converter designers and users; R&D centers; and readers needing industry solutions in variable speed drive systems, such as automation and aviation. The worldwide potential of electric power generation from marine tidal currents, waves, or offshore winds is enormous. The high load factor resulting from the fluid properties and the predictable resource characteristics make tidal and wave energy resources attractive and advantageous for power generation and advantageous when compared to other renewable energies. The technologies are just beginning to reach technical and economic viability to make them potential commercial power sources in the near future. While only a few small projects currently exist, the technology is advancing rapidly and has huge potential for generating bulk power. Moreover, international treaties related to climate control and dwindling fossil fuel resources have encouraged us to harness energy sustainably from such marine renewable sources. Several demonstrative projects have been scheduled to capture tidal and wave energies. A number of these projects have now reached a relatively mature stage and are close to completion. However, very little is known to the academic world about these technologies beyond the basics of their energy conversion principles. While research emphasis is more towards hydrodynamics and turbine design, very limited activities are witnessed in power conversion interface, control, and power quality aspects. Regarding this

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emerging and promising area of research, this book aims to present recent results, serving to promote successful marine renewable energies integration to the grid or to standalone microgrids.

This updated edition of this book provides comprehensive coverage of modern power electronics, addressing all the latest trends and hot-button issues—from PWM rectifiers to renewable energy systems to electromagnetic interference. It features an overview of advanced control methods used in today's power electronic converters, numerous SPICE files of typical power conversion circuits, and an Instructor's Manual with solutions to all problems. An extensive body of examples, exercises, computer assignments, and simulations make it highly suitable as a textbook for undergraduate/graduate students of engineering in electrical engineering, industrial engineering or renewable energy, and practicing engineers.

The first book of its kind, *Power Converters and AC Electrical Drives with Linear Neural Networks* systematically explores the application of neural networks in the field of power electronics, with particular emphasis on the sensorless control of AC drives. It presents the classical theory based on space-vectors in identification, discusses control of electrical drives and power converters, and examines improvements that can be attained when using linear neural networks. The book integrates power electronics and electrical drives with artificial neural networks (ANN). Organized into four parts. This book constitutes the refereed post-conference proceedings of the First EAI International Conference on Sustainable Energy for Smart Cities, SESC 2029, held as part of the Smart City 360° Summit event in Braga, Portugal, in December 2019. The 23 revised full papers were carefully reviewed and selected from 38 submissions. They contribute to answer complex societal, technological, and economic

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problems of emergent smart cities. The papers are organized thematically in tracks, starting with mobile systems, cloud resource management and scheduling, machine learning, telecommunication systems, and network management. The papers are grouped in topical sections on electric mobility; power electronics; intelligent, transportation systems; demand response; energy; smart homes; Internet of Things; monitoring; network communications; power quality; power electronics.

Power electronic converters can be broadly classified as AC to DC, DC to AC, DC to DC and AC to AC converters. AC to AC converters can be further classified as AC Controllers or AC regulators, Cycloconverters and Matrix converters. AC controllers and cycloconverters are fabricated using Silicon Controlled Rectifiers (SCR) whereas matrix converters are built using semiconductor bidirectional switches. This text book provides a summary of AC to AC Converter modelling excluding AC controllers. The software Simulink® by Mathworks Inc., USA is used to develop the models of AC to AC Converters presented in this text book. The term model in this text book refers to SIMULINK model. This text book is mostly suitable for researchers and practising professional engineers in the industry working in the area of AC to AC converters. Features Provides a summary of AC to AC Converter modelling excluding AC controllers Includes models for three phase AC to three phase AC matrix converters using direct and indirect space vector modulation algorithm Presents new applications such as single and dual programmable AC to DC rectifier with derivations for output voltage Displays Hardware-in-the Loop simulation of a three phase AC to single phase AC matrix converter Provides models for three phase multilevel matrix converters, Z-source Direct and Quasi Z-source Indirect matrix converters; a model for speed control and brake by plugging of three phase

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induction motor and separately excited DC motors using matrix converter; a model for a new single phase and three phase sine wave direct AC to AC Converter without a DC link using three winding transformers and that for a square wave AC to square wave AC converter using a DC link; models for variable frequency, variable voltage AC to AC power supply; models for Solid State Transformers using Dual Active Bridge topology and a new direct AC to AC Converter topology; and models for cycloconverters and indirect matrix converters

Modern power electronic converters are involved in a very broad spectrum of applications: switched-mode power supplies, electrical-machine-motion-control, active power filters, distributed power generation, flexible AC transmission systems, renewable energy conversion systems and vehicular technology, among them. Power Electronics Converters Modeling and Control teaches the reader how to analyze and model the behavior of converters and so to improve their design and control. Dealing with a set of confirmed algorithms specifically developed for use with power converters, this text is in two parts: models and control methods. The first is a detailed exposition of the most usual power converter models: - switched and averaged models; - small/large-signal models; and - time/frequency models. The second focuses on three groups of control methods: - linear control approaches normally associated with power converters; - resonant controllers because of their significance in grid-connected applications; and - nonlinear control methods including feedback linearization, stabilizing, passivity-based, and variable-structure control. Extensive case-study illustration and end-of-chapter exercises reinforce the study material. Power Electronics Converters Modeling and Control addresses the needs of graduate students interested in power electronics, providing a balanced understanding of theoretical ideas coupled with pragmatic

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tools based on control engineering practice in the field. Academics teaching power electronics will find this an attractive course text and the practical points make the book useful for self tuition by engineers and other practitioners wishing to bring their knowledge up to date.

A unique approach to sensorless control and regulator design of electric drives Based on the author's vast industry experience and collaborative works with other industries, Control of Electric Machine Drive Systems is packed with tested, implemented, and verified ideas that engineers can apply to everyday problems in the field. Originally published in Korean as a textbook, this highly practical updated version features the latest information on the control of electric machines and apparatus, as well as a new chapter on sensorless control of AC machines, a topic not covered in any other publication. The book begins by explaining the features of the electric drive system and trends of development in related technologies, as well as the basic structure and operation principles of the electric machine. It also addresses steady state characteristics and control of the machines and the transformation of physical variables of AC machines using reference frame theory in order to provide a proper foundation for the material. The heart of the book reviews several control algorithms of electric machines and power converters, explaining active damping and how to regulate current, speed, and position in a feedback manner. Seung-Ki Sul introduces tricks to enhance the control performance of the electric machines, and the algorithm to detect the phase angle of an AC source and to control DC link voltages of power converters. Topics also covered are: Vector control Control algorithms for position/speed sensorless drive of AC machines Methods for identifying the parameters of electric machines and power converters The matrix algebra to model a three-phase AC machine in d-q-n axes Every chapter

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features exercise problems drawn from actual industry experience. The book also includes more than 300 figures and offers access to an FTP site, which provides MATLAB programs for selected problems. The book's practicality and realworld relatability make it an invaluable resource for professionals and engineers involved in the research and development of electric machine drive business, industrial drive designers, and senior undergraduate and graduate students. To obtain instructor materials please send an email to pressbooks@ieee.org To visit this book's FTP site to download MATLAB codes, please click on this link: ftp://ftp.wiley.com/public/sci_tech_med/electric_machine/ MATLAB codes are also downloadable from Wiley Booksupport Site at <http://booksupport.wiley.com> Integrating renewable energy and other distributed energysources into smart grids, often via power inverters, is arguablythe largest “new frontier” for smart grid advancements. Inverters should be controlled properly so that their integration does not jeopardize the stability and performance of power systems and a solid technical backbone is formed to facilitate other functions and services of smart grids. This unique reference offers systematic treatment of important control problems in power inverters, and different general converter theories. Starting at a basic level, it presents conventional power conversion methodologies and then ‘non-conventional’ methods, with a highly accessible summary of the latest developments in power inverters as well as insight into the grid connection of renewable power. Consisting of four parts – Power Quality Control, Neutral Line Provision, Power Flow Control, and Synchronisation – this book fully demonstrates the integration of control and power electronics. Key features include: the fundamentals of power processing and hardware design innovative control strategies to systematically treat the control

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of power inverters extensive experimental results for most of the control strategies presented the pioneering work on “synchronverters” which has gained IET Highly Commended Innovation Award Engineers working on inverter design and those at power system utilities can learn how advanced control strategies could improve system performance and work in practice. The book is a useful reference for researchers who are interested in the area of control engineering, power electronics, renewable energy and distributed generation, smart grids, flexible AC transmission systems, and power systems for more-electric aircraft and all-electric ships. This is also a handy text for graduate students and university professors in the areas of electrical power engineering, advanced control engineering, power electronics, renewable energy and smart grid integration.

Power converters and electric machines represent essential components in all fields of electrical engineering. In fact, we are heading towards a future where energy will be more and more electrical: electrical vehicles, electrical motors, renewables, storage systems are now widespread. The ongoing energy transition poses new challenges for interfacing and integrating different power systems. The constraints of space, weight, reliability, performance, and autonomy for the electric system have increased the attention of scientific research in order to find more and more appropriate technological solutions. In this context, power converters and electric machines assume a key role in enabling higher performance of electrical power conversion. Consequently, the design and control of power converters and electric machines shall be developed accordingly to the requirements of the specific application, thus leading to more specialized solutions, with the aim of enhancing the reliability, fault tolerance, and flexibility of the next generation power systems.

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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

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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

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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

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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. In modern industries, electrical energy conversion systems consist of two main parts: electrical machines and power electronic converters. With global electricity use at an all-time high, uninterrupted operation of electrical power converters is essential. Reliability in Power Electronics and Electrical Machines: Industrial Applications and Performance Models provides an in-depth analysis of reliability in electrical energy converters as well as strategies for designing dependable

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power electronic converters and electrical machines.

Featuring a comprehensive discussion on the topics of reliability design and measurement, failure mechanisms, and specific issues pertaining to quality, efficiency, and durability, this timely reference source offers practical examples and research-based results for use by engineers, researchers, and advanced-level students.

The text starts with basic functionality and the role of electrical machines in their typical applications. The effort of applying coordinate transforms is justified by obtaining a more intuitive, concise and easy-to-use model. Mathematics reduced to a necessary minimum, priority is given to bringing up the system view and explaining the use and external characteristics of machines on their electrical and mechanical ports. The aspects of machine design and construction are of secondary importance. Covering the most relevant concepts relating to machine size, torque and power, the book explains the losses and secondary effects, outlining cases and conditions where some secondary phenomena are neglected. While the goal of developing and using machine mathematical models, equivalent circuits and mechanical characteristics persists through the book, the focus is kept on physical insight of electromechanical conversion process. Design and construction of practical machines is discussed to the extent needed to understand the principles of operation, power losses and cooling, and the problems of power supply and control of electric machines. Details such as the slot shape and the disposition of permanent magnets are covered and their effects on the machine parameters and performance.

In this book, 20 papers focused on different fields of power electronics are gathered. Approximately half of the papers are focused on different control issues and techniques, ranging from the computer-aided design of digital compensators to

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more specific approaches such as fuzzy or sliding control techniques. The rest of the papers are focused on the design of novel topologies. The fields in which these controls and topologies are applied are varied: MMCs, photovoltaic systems, supercapacitors and traction systems, LEDs, wireless power transfer, etc.

The first book of its kind, *Power Converters and AC Electrical Drives with Linear Neural Networks* systematically explores the application of neural networks in the field of power electronics, with particular emphasis on the sensorless control of AC drives. It presents the classical theory based on space-vectors in identification, discusses control of electrical drives and power converters, and examines improvements that can be attained when using linear neural networks. The book integrates power electronics and electrical drives with artificial neural networks (ANN). Organized into four parts, it first deals with voltage source inverters and their control. It then covers AC electrical drive control, focusing on induction and permanent magnet synchronous motor drives. The third part examines theoretical aspects of linear neural networks, particularly the neural EXIN family. The fourth part highlights original applications in electrical drives and power quality, ranging from neural-based parameter estimation and sensorless control to distributed generation systems from renewable sources and active power filters. Simulation and experimental results are provided to validate the theories. Written by experts in the field, this state-of-the-art book requires basic knowledge of electrical machines and power electronics, as well as some familiarity with control systems, signal processing, linear algebra, and numerical analysis. Offering multiple paths through the material, the text is suitable for undergraduate and postgraduate students, theoreticians, practicing engineers, and researchers involved in applications of ANNs.

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Provides comprehensive coverage of the basic principles and methods of electric power conversion and the latest developments in the field This book constitutes a comprehensive overview of the modern power electronics.

Various semiconductor power switches are described, complementary components and systems are presented, and power electronic converters that process power for a variety of applications are explained in detail. This third edition updates all chapters, including new concepts in modern power electronics. New to this edition is extended coverage of matrix converters, multilevel inverters, and applications of the Z-source in cascaded power converters. The book is accompanied by a website hosting an instructor's manual, a PowerPoint presentation, and a set of PSpice files for simulation of a variety of power electronic converters.

Introduction to Modern Power Electronics, Third Edition: Discusses power conversion types: ac-to-dc, ac-to-ac, dc-to-dc, and dc-to-ac Reviews advanced control methods used in today's power electronic converters Includes an extensive body of examples, exercises, computer assignments, and simulations Introduction to Modern Power Electronics, Third Edition is written for undergraduate and graduate engineering students interested in modern power electronics and renewable energy systems. The book can also serve as a reference tool for practicing electrical and industrial engineers.

This book discusses the technical, economic, and environmental aspects of electric vehicles and their impact on electrical grids and energy systems. The book is divided into three parts that include load modeling, integration and optimization, and environmental evaluation. Theoretical background and practical examples accompany each section and the authors include helpful tips and hints in the load modeling and optimization sections. This book is intended to

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be a useful tool for undergraduate and graduate students, researchers and engineers who are trying to solve power and engineering problems related electric vehicles. Provides optimization techniques and their applications for energy systems; Discusses the economic and environmental perspectives of electric vehicles; Contains the most comprehensive information about electric vehicles in a single source.

This textbook is intended for engineering students taking courses in power electronics, renewable energy sources, smart grids or static power converters. It is also appropriate for students preparing a capstone project where they need to understand, model, supply, control and specify the grid side power converters. The main goal of the book is developing in students the skills that are required to design, control and use static power converters that serve as an interface between the ac grid and renewable power sources. The same skills can be used to design, control and use the static power converters used within the micro-grids and nano-grids, as the converters that provide the interface between such grids and the external grid. The author's approach starts with basic functionality and the role of grid connected power converters in their typical applications, and their static and dynamic characteristics. Particular effort is dedicated to developing simple, concise, intuitive and easy-to-use mathematical models that summarize the essence of the grid side converter dynamics. Mathematics is reduced to a necessary minimum, solved examples are used extensively to introduce new concepts, and exercises are used to test mastery of new skills.

An in-depth examination of large scale wind projects and electricity production in China Presents the challenges of electrical power system planning, design, operation and control carried out by large scale wind power, from the

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Chinese perspective Focuses on the integration issue of large scale wind power to the bulk power system, probing the interaction between wind power and bulk power systems Wind power development is a burgeoning area of study in developing countries, with much interest in offshore wind farms and several big projects under development English translation of the Chinese language original which won the "Fourth China Outstanding Publication Award nomination" in March 2013

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

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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.

A comprehensive reference of the latest developments in MV drive technology in the area of power converter topologies. This new edition reflects the recent technological advancements in the MV drive industry, such as advanced multilevel converters and drive configurations. It includes three new chapters, Control of Synchronous Motor Drives, Transformerless MV Drives, and Matrix Converter Fed Drives. In addition, there are extensively revised chapters on Multilevel Voltage Source Inverters and Voltage Source Inverter-Fed Drives. This book includes a systematic analysis on a variety of high-power multilevel converters, illustrates important concepts with simulations and experiments, introduces various megawatt drives produced by world leading drive manufacturers, and addresses practical problems and their mitigations methods. This new edition: Provides an in-depth discussion and analysis of various control schemes for the MV synchronous motor drives Examines new technologies developed to eliminate the isolation transformer in the MV drives Discusses the operating principle and modulation schemes of matrix converter (MC) topology and multi-module cascaded matrix converters (CMCs) for MV drives, and their application in commercial MV drives Bin Wu is a Professor and Senior NSERC/Rockwell Automation Industrial Research Chair in Power Electronics and Electric Drives at Ryerson University, Canada. He is a fellow of Institute of Electrical and Electronics Engineers (IEEE), Engineering Institute of Canada (EIC), and Canadian Academy of Engineering (CAE). Dr. Wu has published more than 400 papers and holds more

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than 30 granted/pending US/European patents. He co-authored several books including Power Conversion and Control of Wind Energy Systems and Model Predictive Control of Wind Energy Conversion Systems (both by Wiley-IEEE Press). Mehdi Narimani is a Postdoctoral Research Associate with the Department of Electrical and computer Engineering at Ryerson University, Canada, and Rockwell Automation Canada. He is a senior member of IEEE. Dr. Narimani is author/co-author of more than 50 technical papers and four US/European patents (issued/pending review). His current research interests include power conversion, high power converters, control of power electronics, and renewable energy systems.

Power Converter with Digital Filter Feedback Control presents a logical sequence that leads to the identification, extraction, formulation, conversion, and implementation for the control function needed in electrical power equipment systems. This book builds a bridge for moving a power converter with conventional analog feedback to one with modern digital filter control and enlists the state space averaging technique to identify the core control function in analytical, close form in s-domain (Laplace). It is a useful reference for all professionals and electrical engineers engaged in electrical power equipment/systems design, integration, and management. Offers logical sequences to identification, extraction, formulation, conversion, and implementation for the control function needed Contains step-by-step instructions on how to take existing analog designed power processors and move them to the digital realm Presents ways to extract gain functions for many power converters' power processing stages and their supporting circuitry

Thoroughly updated to encompass the significant technological advances since the publication of the first edition, Electric and Hybrid Vehicles: Design Fundamentals,

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Second Edition presents the design fundamentals, component sizing, and systems interactions of alternative vehicles. This new edition of a widely praised, bestselling textbook maintains the comprehensive, systems-level perspective of electric and hybrid vehicles while covering the hybrid architectures and components of the vehicle in much greater detail. The author emphasizes technical details, mathematical relationships, and design guidelines throughout the text. New to the Second Edition New chapters on sizing and design guidelines for various hybrid architectures, control strategies for hybrid vehicles, powertrain component cooling systems, and in-vehicle communication methods New sections on modeling of energy storage components, tire-road force mechanics, compressed air-storage, DC/DC converters, emission control systems, electromechanical brakes, and vehicle fuel economy Reorganization of power electronics, electric machines, and motor drives sections Enhanced sections on mechanical components that now include more technical descriptions and example problems An emphasis on the integration of mechanical and electrical components, taking into account the interdisciplinary nature of automotive engineering As an advisor to the University of Akron's team in the Challenge X: Crossover to Sustainable Mobility, Dr. Husain knows first-hand how to teach students both the fundamentals and cutting-edge technologies of the next generation of automotives. This text shows students how electrical and mechanical engineers must work together to complete an alternative vehicle system. It empowers them to carry on state-of-the-art research and development in automotive engineering in order to meet today's needs of clean, efficient, and sustainable vehicles.

Modern power electronic converters are involved in a very broad spectrum of applications: switched-mode power supplies, electrical-machine-motion-control, active power

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filters, distributed power generation, flexible AC transmission systems, renewable energy conversion systems and vehicular technology, among them. Electronic power conversion has gained widespread acceptance in power systems applications, electronic power converters are increasingly employed for power conversion and conditioning, compensation, and active filtering. This book presents the fundamentals for analysis and control of a specific class of high-power electronic converters-the three-phase voltage-sourced converter. Voltage-sourced converters in power systems provides a necessary and unprecedented link between the principles of operation and the applications of voltage-sourced converters. Power Electronics Converters Modelling and Control teaches the reader how to analyse and model the behaviour of converters and so to improve their design and control. Dealing with a set of confirmed algorithms specifically developed for use with power converters. This book provides a comprehensive overview of power electronic converters (DC / DC, DC / AC, AC / DC and AC / AC) conventionally used in industrial and transportation applications, specifically for the supply of electric machines with variable speed drop off window. From the perspective of design and sizing, this book presents the different functions encountered in a modular way for power electronics. Power Converters and Their Control details less traditional topics such as matrix converters and multilevel converters. This book also features a case study design of an industrial controller, which is a synthesis (except the AC / AC direct conversion) of the study subjects, including sizing associated passive components. Introducing essential notions in power electronics from both theoretical and technological perspectives Detailed chapters focusing on power supplies for electrical machinery, including a case study of full dimensioning of an industrial variable-speed drive Presented

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from a user's perspective to enable you to apply the theory of power electronics to practical applications

Describes the general principles and current research into Model Predictive Control (MPC); the most up-to-date control method for power converters and drives The book starts with an introduction to the subject before the first chapter on classical control methods for power converters and drives. This covers classical converter control methods and classical electrical drives control methods. The next chapter on Model predictive control first looks at predictive control methods for power converters and drives and presents the basic principles of MPC. It then looks at MPC for power electronics and drives. The third chapter is on predictive control applied to power converters. It discusses: control of a three-phase inverter; control of a neutral point clamped inverter; control of an active front end rectifier, and; control of a matrix converter. In the middle of the book there is Chapter four - Predictive control applied to motor drives. This section analyses predictive torque control of industrial machines and predictive control of permanent magnet synchronous motors. Design and implementation issues of model predictive control is the subject of the final chapter. The following topics are described in detail: cost function selection; weighting factors design; delay compensation; effect of model errors, and prediction of future references. While there are hundreds of books teaching control of electrical energy using pulse width modulation, this will be the very first book published in this new topic. Unique in presenting a completely new theoretic solution to control electric power in a simple way Discusses the application of predictive control in motor drives, with several examples and case studies Matlab is included on a complementary website so the reader can run their own simulations

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