

Voltage Sourced Converters In Power Systems Modeling Control And Applications

This book presents the latest cutting-edge technology in high-power converters and medium voltage drives, and provides a complete analysis of various converter topologies, modulation techniques, practical drive configurations, and advanced control schemes. Supplemented with more than 250 illustrations, the author illustrates key concepts with simulations and experiments. Practical problems, along with accompanying solutions, are presented to help you tackle real-world issues. The Flexible AC Transmission System (FACTS)--a new technology based on power electronics--offers an opportunity to enhance controllability, stability, and power transfer capability of ac transmission systems. Two pioneers in the field provide in-depth discussions on power semiconductor devices, voltage-sourced and current-sourced converters, specific FACTS controllers, and major FACTS applications in the U.S.

For very high voltage or very high current applications, the power industry still relies on thyristor-based Line Commutated Conversion (LCC), which limits the power controllability to two quadrant operation. However, the ratings of self-commutating switches such as the Insulated-Gate Bipolar Transistor (IGBT) and Integrated Gate-Commutated Thyristor (IGCT), are reaching levels that make the technology possible for very high power applications. This unique book reviews the present state and future prospects of self-commutating static power converters for applications requiring either ultra high voltages (over 600 kV) or ultra high currents (in hundreds of kA). It is an important reference for electrical engineers working in the areas of power generation, transmission and distribution, utilities, manufacturing and consulting organizations. All topics in this area are held in this one complete volume. Within these pages, expect to find thorough coverage on: modelling and control of converter dynamics; multi-level Voltage Source Conversion (VSC) and Current Source Conversion (CSC); ultra high-voltage VSC and CSC DC transmission; low voltage high DC current AC-DC conversion; industrial high current applications; power conversion for high energy storage. This text has a host of helpful material that also makes it a useful source of knowledge for final year engineering students specializing in power engineering, and those involved in postgraduate research.

Control of Power Electronic Converters and Systems, Volume 3, explores emerging topics in the control of power electronics and converters, including the theory behind control, and the practical operation, modeling, and control of basic power system models. This book introduces the most important controller design methods, including both analog and digital procedures. This reference explains the dynamic characterization of terminal behavior for converters, as well as preserving the stability and power quality of modern power systems. Useful for engineers in emerging applications of power electronic converters and those combining control design methods into different applications in power electronics technology. Addressing controller interactions - in light of increasing renewable energy integration and related challenges with stability and power quality - is becoming more frequent in power converters and passive components. Discusses different applications and their control in integrated renewable energy systems Introduces the most important controller design methods, both in analog and digital Describes different important applications to be used in future industrial products Explains the dynamic characterization of terminal behavior for converters

This book discusses HVDC grids based on multi-terminal voltage-source converters (VSC), which is suitable for the connection of offshore wind farms and a possible solution for a continent wide overlay grid. HVDC Grids: For Offshore and Supergrid of the Future begins by introducing and analyzing the motivations and energy policy drives for developing offshore grids and the European Supergrid. HVDC transmission technology and offshore equipment are described in the second part of the book. The third part of the book discusses how HVDC grids can be developed and integrated in the existing power system. The fourth part of the book focuses on HVDC grid integration, in studies, for different time domains of electric power systems. The book concludes by discussing developments of advanced control methods and control devices for enabling DC grids. Presents the technology of the future offshore and HVDC grid Explains how offshore and HVDC grids can be integrated in the existing power system Provides the required models to analyse the different time domains of power system studies: from steady-state to electromagnetic transients This book is intended for power system engineers and academics with an interest in HVDC or power systems, and policy makers. The book also provides a solid background for researchers working with VSC-HVDC technologies, power electronic devices, offshore wind farm integration, and DC grid protection.

"Presents a comprehensive modeling framework for MTDC grids which is compatible with the standard AC system modeling for stability studies"--

HVDC and FACTS Controllers: Applications of Static Converters in Power Systems focuses on the technical advances and developments that have taken place in the past ten years or so in the fields of High Voltage DC transmission and Flexible AC transmission systems. These advances (in HVDC transmission and FACTS) have added a new dimension to power transmission capabilities. The book covers a wide variety of topics, some of which are listed below: -Current Source and Voltage Source Converters, -Synchronization Techniques for Power Converters, -Capacitor Commutated Converters, -Active Filters, -Typical Disturbances on HVDC Systems, -Simulation Techniques, -Static Var Compensators based on Chain Link Converters, -Advanced Controllers, -Trends in Modern HVDC. In addition to EHV transmission, HVDC technology has impacted on a number of other areas as well. As an example, a chapter dealing with HVDC Light applications is included providing recent information on both on-shore and off-shore applications of wind farms.

Electronic power conversion. Fundamentals, DC/AC half - bridge converter, control of half - bridge converter, three - level, three - phase, neutral - point clamped, voltage - sourced converter. Applications, static compensator, back to back HVDC conversion system.

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. 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 covers the fundamentals of power electronic converter modeling and control, digital simulation, and experimental studies in the area of renewable energy systems and AC/DC microgrid. Recent advanced control methods for voltage source inverters (VSIs) and the hierarchical controlled islanded microgrid are discussed, including the mathematical modeling, controller synthesis, parameter selection and multi-scale stability analysis, and consensus-based control strategies for the microgrid and microgrid clusters. The book will be an invaluable technical reference for practicing engineers and researchers working in the areas of renewable energy, power electronics, energy internet, and smart grid. It can also be utilized as reference book for undergraduate and postgraduate students in electrical engineering.

Flexible AC Transmission Systems (FACTS): Newton Power-Flow Modeling of Voltage-Sourced Converter-Based Controllers introduces different voltage-sourced converter (VSC)-based FACTS controllers and VSC-based high-voltage direct current (VSC-HVDC) systems and their working principles, explaining how FACTS controllers exchange real and reactive power with systems. Subsequently, the book: Describes the Newton–Raphson method and its application for solving the power-flow problem Presents the Newton power-flow modeling of the static synchronous series compensator (SSSC), unified power-flow controller (UPFC), interline power-flow controller (IPFC), generalized unified power-flow controller (GUPFC), and static synchronous compensator (STATCOM), accommodating the practical device constraint limits (because of the unique modeling strategy, the existing Newton power-flow codes can be reused) Develops a unified Newton power-flow model of AC systems incorporating multiterminal VSC-HVDC systems with pulse-width modulation (PWM) control schemes, directly yielding the VSC modulation indices from the power-flow solution Provides numerous case studies for validation of Newton power-flow models, elaborating on the occurrences and checking of unrealistic power-flow solutions in isolated cases Includes detailed derivations of all the difficult formulae as well as solved problems on typical VSC-based FACTS controllers Flexible AC Transmission Systems (FACTS): Newton Power-Flow Modeling of Voltage-Sourced Converter-Based Controllers assumes at least an undergraduate-level understanding of engineering mathematics, network analysis, electrical machines, electrical power systems, and power electronics. Thus, the book provides a valuable reference for practitioners as well as senior-undergraduate and graduate students in electrical engineering and electrical power systems.

Model Predictive Control of Wind Energy Conversion Systems addresses the predicative control strategy that has emerged as a promising digital control tool within the field of power electronics, variable-speed motor drives, and energy conversion systems. The authors provide a comprehensive analysis on the model predictive control of power converters employed in a wide variety of variable-speed wind energy conversion systems (WECS). The contents of this book includes an overview of wind energy system configurations, power converters for variable-speed WECS, digital control techniques, MPC, modeling of power converters and wind generators for MPC design. Other topics include the mapping of continuous-time models to discrete-time models by various exact, approximate, and quasi-exact discretization methods, modeling and control of wind turbine grid-side two-level and multilevel voltage source converters. The authors also focus on the MPC of several power converter configurations for full variable-speed permanent magnet synchronous generator based WECS, squirrel-cage induction generator based WECS, and semi-variable-speed doubly fed induction generator based WECS. Furthermore, this book: Analyzes a wide variety of practical WECS, illustrating important concepts with case studies, simulations, and experimental results Provides a step-by-step design procedure for the development of predictive control schemes for various WECS configurations Describes continuous- and discrete-time modeling of wind generators and power converters, weighting factor selection, discretization methods, and extrapolation techniques Presents useful material for other power electronic applications such as variable-speed motor drives, power quality conditioners, electric vehicles, photovoltaic energy systems, distributed generation, and high-voltage direct current transmission. Explores S-Function Builder programming in MATLAB environment to implement various MPC strategies through the companion website Reflecting the latest technologies in the field, Model Predictive Control of Wind Energy Conversion Systems is a valuable reference for academic researchers, practicing engineers, and other professionals. It can also be used as a textbook for graduate-level and advanced undergraduate courses.

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

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.

Grid converters are the key player in renewable energy integration. The high penetration of renewable energy systems is calling

for new more stringent grid requirements. As a consequence, the grid converters should be able to exhibit advanced functions like: dynamic control of active and reactive power, operation within a wide range of voltage and frequency, voltage ride-through capability, reactive current injection during faults, grid services support. This book explains the topologies, modulation and control of grid converters for both photovoltaic and wind power applications. In addition to power electronics, this book focuses on the specific applications in photovoltaic wind power systems where grid condition is an essential factor. With a review of the most recent grid requirements for photovoltaic and wind power systems, the book discusses these other relevant issues: modern grid inverter topologies for photovoltaic and wind turbines islanding detection methods for photovoltaic systems synchronization techniques based on second order generalized integrators (SOGI) advanced synchronization techniques with robust operation under grid unbalance condition grid filter design and active damping techniques power control under grid fault conditions, considering both positive and negative sequences Grid Converters for Photovoltaic and Wind Power Systems is intended as a coursebook for graduated students with a background in electrical engineering and also for professionals in the evolving renewable energy industry. For people from academia interested in adopting the course, a set of slides is available for download from the website. www.wiley.com/go/grid_converters

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 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.

Presents the latest developments in switchgear and DC/DC converters for DC grids, and includes substantially expanded material on MMC HVDC This newly updated edition covers all HVDC transmission technologies including Line Commutated Converter (LCC) HVDC; Voltage Source Converter (VSC) HVDC, and the latest VSC HVDC based on Modular Multilevel Converters (MMC), as well as the principles of building DC transmission grids. Featuring new material throughout, High Voltage Direct Current Transmission: Converters, Systems and DC Grids, 2nd Edition offers several new chapters/sections including one on the newest MMC converters. It also provides extended coverage of switchgear, DC grid protection and DC/DC converters following the latest developments on the market and in research projects. All three HVDC technologies are studied in a wide range of topics, including: the basic converter operating principles; calculation of losses; system modelling, including dynamic modelling; system control; HVDC protection, including AC and DC fault studies; and integration with AC systems and fundamental frequency analysis. The text includes: A chapter dedicated to hybrid and mechanical DC circuit breakers Half bridge and full bridge MMC: modelling, control, start-up and fault management A chapter dedicated to unbalanced operation and control of MMC HVDC The advancement of protection methods for DC grids Wideband and high-order modeling of DC cables Novel treatment of topics not found in similar books, including SimPowerSystems models and examples for all HVDC topologies hosted by the 1st edition companion site. High Voltage Direct Current Transmission: Converters, Systems and DC Grids, 2nd Edition serves as an ideal textbook for a graduate-level course or a professional development course.

This book looks at the control of voltage source converter based high voltage direct current (VSC-HVDC). The objective is to understand the control structure of the VSC-HVDC system and establish the tuning criteria for the proportional-integral (PI) control of the converter controllers. Coverage includes modeling of the VSC-based HVDC transmission system using MATLAB and Simulink simulation package; implementation of control strategies for the VSC-based HVDC transmission system; and analysis of the developed system behavior under different conditions (normal and fault conditions). The book provides researchers, students, and engineers working in electrical power system transmission and power electronics and control in power transmission with a good understanding of the VSC-based HVDC transmission system concept and its behavior.

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.

Provides insight on both classical means and new trends in the application of power electronic and artificial intelligence techniques in power system operation and control This book presents advanced solutions for power system controllability improvement, transmission capability enhancement and operation planning. The book is organized into three parts. The first part describes the CSC-HVDC and VSC-HVDC technologies, the second part presents the FACTS devices, and the third part refers to the artificial intelligence techniques. All technologies and tools approached in this book are essential for power system development to comply with the smart grid requirements. Discusses detailed operating principles and diagrams, theory of modeling, control strategies and physical installations around the world of HVDC and FACTS systems Covers a wide range of Artificial Intelligence techniques that are successfully applied for many power system problems, from planning and monitoring to operation and control Each chapter is carefully edited, with drawings and illustrations that helps the reader to easily understand the principles of operation or application Advanced Solutions in Power Systems: HVDC, FACTS, and Artificial Intelligence is written for graduate students, researchers in transmission and distribution networks, and power system operation. This book also serves as a reference for professional software developers and practicing engineers.

Digital Control in Power Electronics presents students of electrical engineering a basic introduction to typical power converter control problems, their digital solutions, and the most widespread digital control techniques. Although the presentation has been limited to a single converter topology (the half bridge voltage source inverter), the control topics represent a significant spectrum of the more frequently

encountered digital control applications in power electronics. Authors Paolo Mattavelli and Simone Buso introduce the reader to basic control problems in power electronic circuits in order to illustrate widely applied digital solutions to these problems. They also aim to raise students' awareness of discrete time control theory, stimulating new developments in its application to power converters.

Because of the demand for higher efficiencies, smaller output ripple, and smaller converter size for modern power electronic systems, integrated power electronic converters could soon replace conventional switched-mode power supplies. Synthesized integrated converters and related digital control techniques address problems related to cost, space, flexibility, energy efficiency, and voltage regulation—the key factors in digital power management and implementation. Meeting the needs of professionals working in power electronics, as well as advanced engineering students, *Integrated Power Electronic Converters and Digital Control* explores the many benefits associated with integrated converters. This informative text details boost type, buck type, and buck-boost type integrated topologies, as well as other integrated structures. It discusses concepts behind their operation as well specific applications. Topics discussed include: Isolated DC-DC converters such as flyback, forward, push-pull, full-bridge, and half-bridge Power factor correction and its application Definition of the integrated switched-mode power supplies Steady-state analysis of the boost integrated flyback rectifier energy storage converter Dynamic analysis of the buck integrated forward converter Digital control based on the use of digital signal processors (DSPs) With innovations in digital control becoming ever more pervasive, system designers continue to introduce products that integrate digital power management and control integrated circuit solutions, both hybrid and pure digital. This detailed assessment of the latest advances in the field will help anyone working in power electronics and related industries stay ahead of the curve.

The development of power semiconductors with greater ratings and improved characteristics has meant that the power industry has become more willing to develop new converter configurations. These new configurations take advantage of the higher controllability and switching frequencies of the new devices. The next few years will decide which of the proposed technologies will dominate future power transmission systems. *Flexible Power Transmission* is a comprehensive guide to the high voltage direct current (HVDC) options available, helping the reader to make informed decisions for designing future power transmission systems. The book includes: a full description of the principles and components in existing converter technology, as well as alternative proposals for self-commutating conversion; A review of the state of power semiconductors suited to HVDC transmission and present proposals for multi-level HVDC transmission. a detailed overview of the flexible HVDC methods for improving controllability and increasing power transfer capability in electrical power systems. up-to-date information on thyristor-based HVDC technology. coverage of new pulse width modulation (PWM) transmission technology and multi-level voltage source conversion (VSC) and current source conversion (CSC). An excellent reference for professional power engineers, *Flexible Power Transmission* is also a useful guide for power system researchers as well as lecturers and students in power systems and power electronics disciplines.

This book provides a unique approach to derive model-based torque controllers for all types of Lorentz force machines, i.e. DC, synchronous and induction machines. The rotating transformer model forms the basis for the generalized modeling approach of rotating field machines, which leads to the development of universal field-oriented control algorithms. Contrary to this, direct torque control algorithms, using observer-based methods, are developed for switched reluctance machines. Tutorials are included at the end of each chapter, and the reader is encouraged to execute these tutorials in order to gain familiarity with the dynamic behavior of drive systems. This updated edition uses PLECS® simulation and vector processing tools that were specifically adopted for the purpose of these hands-on tutorials. Hence, *Advanced Electrical Drives* encourages “learning by doing” and the experienced drive specialist may find the simulation tools useful to design high-performance torque controllers. Although it is a powerful reference in its own right, when used in conjunction with the companion texts *Fundamentals of Electrical Drives* and *Applied Control of Electrical Drives*, this book provides a uniquely comprehensive reference set that takes readers all the way from understanding the basics of how electrical drives work, to deep familiarity with advanced features and models, to a mastery of applying the concepts to actual hardware in practice. Teaches readers to perform insightful analysis of AC electrical machines and drives; Introduces new modeling methods and modern control techniques for switched reluctance drives; Updated to use PLECS® simulation tools for modeling electrical drives, including new and more experimental results; Numerous tutorials at end of each chapter to learn by doing, step-by-step; Includes extra material featuring “build and play” lab modules, for lectures and self-study.

This book develops some methods and structures to improve the power inverters for different applications in a single-phase or three-phase output in recent years. The reduction of the switching devices and multilevel inverters as changing structure for the power inverters and PDM and PWM methods as changing control methods for the power inverter are studied in this book. Moreover, power inverters are developed to supply open-ended loads. Furthermore, the basic and advanced aspects of the electric drives that are control based are taught for induction motor (IM) based on power inverters suitable for both undergraduate and postgraduate levels. The main objective of this book is to provide the necessary background to improve and implement the high-performance inverters. Once the material in this book has been mastered, the reader will be able to apply these improvements in the power inverters to his or her problems for high-performance power inverters.

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 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.

A key issue for power electronic converters is the ability to tackle periodic signals in electrical power processing to precisely and flexibly convert and regulate electrical power. This book provides complete analysis and synthesis methods for periodic control systems. It covers the control, compensation, and filtering of periodic signals in power electronic power processing and proposes a unified framework for housing periodic control schemes for power converters, providing a general proportional-integral-derivative control solution to periodic signal compensation in extensive engineering applications - a perfect periodic control solution for power electronic conversion. It provides a number of demonstrative practical examples of the application of periodic control to:

standalone constant-voltage-constant-frequency (CVCF) singlephase Pulse Width Modulation (PWM) inverters; standalone CVCF singlephase High Frequency Link (HFL) inverters; standalone CVCF three-phase PWM inverters; grid-connected single-phase inverters; grid-connected singlephase "Cycloconverter" type HFL rectifiers; grid-connected three-phase PWM inverters; programmable AC power sources; shunt active power filters; and UPS systems. Periodic Control of Power Electronic Converters is of key importance for researchers and engineers in the field of power electronic converter systems and their applications, for control specialists exploring new applications of control theory in power electronics, and for advanced university students in these fields.

A voltage converter changes the voltage of an electrical power source and is usually combined with other components to create a power supply. This title is devoted to the control of static converters, which deals with pulse-width modulation (PWM) techniques, and also discusses methods for current control. Various application cases are treated. The book is ideal for professionals in power engineering, power electronics, and electric drives industries, as well as practicing engineers, university professors, postdoctoral fellows, and graduate students.

Impedance Source Power Electronic Converters brings together state of the art knowledge and cutting edge techniques in various stages of research related to the ever more popular impedance source converters/inverters. Significant research efforts are underway to develop commercially viable and technically feasible, efficient and reliable power converters for renewable energy, electric transportation and for various industrial applications. This book provides a detailed understanding of the concepts, designs, controls, and application demonstrations of the impedance source converters/inverters. Key features: Comprehensive analysis of the impedance source converter/inverter topologies, including typical topologies and derived topologies. Fully explains the design and control techniques of impedance source converters/inverters, including hardware design and control parameter design for corresponding control methods. Presents the latest power conversion solutions that aim to advance the role of power electronics into industries and sustainable energy conversion systems. Compares impedance source converter/inverter applications in renewable energy power generation and electric vehicles as well as different industrial applications. Provides an overview of existing challenges, solutions and future trends. Supported by calculation examples, simulation models and results. Highly accessible, this is an invaluable resource for researchers, postgraduate/graduate students studying power electronics and its application in industry and renewable energy conversion as well as practising R&D engineers. Readers will be able to apply the presented material for the future design of the next generation of efficient power electronic converters/inverters.

An invaluable academic reference for the area of high-power converters, covering all the latest developments in the field High-power multilevel converters are well known in industry and academia as one of the preferred choices for efficient power conversion. Over the past decade, several power converters have been developed and commercialized in the form of standard and customized products that power a wide range of industrial applications. Currently, the modular multilevel converter is a fast-growing technology and has received wide acceptance from both industry and academia. Providing adequate technical background for graduate- and undergraduate-level teaching, this book includes a comprehensive analysis of the conventional and advanced modular multilevel converters employed in motor drives, HVDC systems, and power quality improvement. Modular Multilevel Converters: Analysis, Control, and Applications provides an overview of high-power converters, reference frame theory, classical control methods, pulse width modulation schemes, advanced model predictive control methods, modeling of ac drives, advanced drive control schemes, modeling and control of HVDC systems, active and reactive power control, power quality problems, reactive power, harmonics and unbalance compensation, modeling and control of static synchronous compensators (STATCOM) and unified power quality compensators. Furthermore, this book: Explores technical challenges, modeling, and control of various modular multilevel converters in a wide range of applications such as transformer and transformerless motor drives, high voltage direct current transmission systems, and power quality improvement Reflects the latest developments in high-power converters in medium-voltage motor drive systems Offers design guidance with tables, charts graphs, and MATLAB simulations Modular Multilevel Converters: Analysis, Control, and Applications is a valuable reference book for academic researchers, practicing engineers, and other professionals in the field of high power converters. It also serves well as a textbook for graduate-level students.

A comprehensive guide to approaches to decoding, synthesizing and modeling pulse width modulation (PWM) converters Origin of Power Converters explores the original converter and provides a systematic examination of the development and modeling of power converters based on decoding and synthesizing approaches. The authors—noted experts on the topic—present an introduction to the origins of the converter and detail the fundamentals related to power the converter's evolution. They cover a range of converter synthesis approaches, synthesis of multi-stage/multi-level converters, extension of hard-switching converters to soft-switching ones, and determination of switch-voltage stresses in the converters. In later chapters, this comprehensive resource reviews conventional two-port network theory and the state-space averaged (SSA) modeling approach, from which systematic modeling approaches are based on the graft switch technique. In addition, the book reviews the converter layer scheme and some fundamental circuit theories. This important book: • Contains a review of several typical transfer codes, such as step-down, step-up, step-up&down, and \pm step-up&down • Describes the syntheses of pulse width modulation (PWM) converters such as voltage-fed z-source, current-fed z-source, quasi z-source, switched capacitor, and switched inductor converters • Presents two application examples based on previously proposed modeling approaches Written for academic researchers, graduate students, and seniors in power electronics, Origin of Power Converters provides a comprehensive understanding of the evolution of the converter and its applications.

DC/DC conversion techniques have undergone rapid development in recent decades. With the pioneering work of authors Fang Lin Luo and Hong Ye, DC/DC converters have now been sorted into their six generations, and by a rough count, over 800 different topologies currently exist, with more being developed each year. Advanced DC/DC Converters, Second Edition offers a concise, practical presentation of DC/DC converters, summarizes the spectrum of conversion technologies, and presents new ideas and more than 200 new topologies. Beginning with background material on DC/DC conversion, the book later discusses both voltage lift and super-lift converters. It then proceeds through each generation, including the groundbreaking sixth generation—converters developed by the authors that can be cascaded for high voltage transfer gain. This new edition updates every chapter and offers three new chapters. The introduction of the super-lift technique is an outstanding achievement in DC/DC conversion technology, and the ultra-lift technique and hybrid split-capacitor/inductor applied in Super-Lift Luo-Converters are introduced in Chapters 7 and 8. In Chapter 9, the authors have theoretically defined a new concept, Energy Factor (EF), researched the relations between

EF and the mathematical modelling for power DC/DC converters, and demonstrated the modeling method for two converters. More than 320 figures, 60 tables, and 500 formulae allow the reader to more easily grasp the overall structure of advanced DC/DC converters, provide fast access to precise data, and help them to quickly determine the values of their own circuit components.

Voltage-Sourced Converters in Power Systems Modeling, Control, and Applications John Wiley & Sons

Modern semiconductor devices have reached high current and voltage levels, and their power-handling limits can be extended if they are used in multilevel converter configurations. To create high-performance and reliable control designs, however, engineers need in-depth understanding of the characteristics and operation of these topologies. Multilevel Converters for Industrial Applications presents a thorough and comprehensive analysis of multilevel converters with a common DC voltage source. The book offers a novel perspective to help readers understand the principles of the operation of voltage-source multilevel converters as power processors, and their capabilities and limitations. The book begins with an overview of medium-voltage power converters and their applications. It then analyzes the topological characteristics of the diode-clamped multilevel converter, the flying capacitor multilevel converter, and the asymmetric cascaded multilevel converter. For each topology, the authors highlight particular control issues and design trade-offs. They also develop relevant modulation and control strategies. Numerous graphical representations aid in the analysis of the topologies and are useful for beginning the analysis of new multilevel converter topologies. The last two chapters of the book explore two case studies that analyze the behavior of the cascade asymmetric multilevel converter as a distribution static compensator and shunt active power filter, and the behavior of the diode-clamped topology configured as a back-to-back converter. These case studies demonstrate how to address the associated control problems with advanced control and modulation schemes. Examining recent advances, this book provides deep insight on the design of high-power multilevel converters and their applications. It is a valuable reference for anyone interested in medium-voltage power conversion, which is increasingly being used in industry and in renewable energy and distributed generation systems to improve efficiency and operation flexibility. Control of Power Electronic Converters and Systems examines the theory behind power electronic converter control, including operation, modeling and control of basic converters. The book explores how to manipulate components of power electronics converters and systems to produce a desired effect by controlling system variables. Advances in power electronics enable new applications to emerge and performance improvement in existing applications. These advances rely on control effectiveness, making it essential to apply appropriate control schemes to the converter and system to obtain the desired performance. Discusses different applications and their control Explains the most important controller design methods both in analog and digital Describes different important applications to be used in future industrial products Covers voltage source converters in significant detail Demonstrates applications across a much broader context

This book examines a number of topics, mainly in connection with advances in semiconductor devices and magnetic materials and developments in medium and large-scale renewable power plant technologies, grid integration techniques and new converter topologies, including advanced digital control systems for medium-voltage networks. The book's individual chapters provide an extensive compilation of fundamental theories and in-depth information on current research and development trends, while also exploring new approaches to overcoming some critical limitations of conventional grid integration technologies. Its main objective is to present the design and implementation processes for medium-voltage converters, allowing the direct grid integration of renewable power plants without the need for step-up transformers.

Filling the need for a reference that explains the behavior of power electronic converters, this book provides information currently unavailable in similar texts on power electronics. Clearly organized into four parts, the first treats the dynamics and control of conventional converters, while the second part covers the dynamics and control of DC-DC converters in renewable energy applications, including an introduction to the sources as well as the design of current-fed converters applying duality-transformation methods. The third part treats the dynamics and control of three-phase rectifiers in voltage-sourced applications, and the final part looks at the dynamics and control of three-phase inverters in renewable-energy applications. With its future-oriented perspective and advanced, first-hand knowledge, this is a prime resource for researchers and practicing engineers needing a ready reference on the design and control of power electronic converters.

The concept of the smart grid promises the world an efficient and intelligent approach of managing energy production, transportation, and consumption by incorporating intelligence, efficiency, and optimality into the power grid. Both energy providers and consumers can take advantage of the convenience, reliability, and energy savings achieved by real-time and intelligent energy management. To this end, the current power grid is experiencing drastic changes and upgrades. For instance, more significant green energy resources such as wind power and solar power are being integrated into the power grid, and higher energy storage capacity is being installed in order to mitigate the intermittency issues brought about by the variable energy resources. At the same time, novel power electronics technologies and operating strategies are being invented and adopted. For instance, Flexible AC transmission systems and phasor measurement units are two promising technologies for improving the power system reliability and power quality. Demand side management will enable the customers to manage the power loads in an active fashion. As a result, modeling and control of modern power grids pose great challenges due to the adoption of new smart grid technologies. In this book, chapters regarding representative applications of smart grid technologies written by world-renowned experts are included, which explain in detail various innovative modeling and control methods.

In this original book on model predictive control (MPC) for power electronics, the focus is put on high-power applications with multilevel converters operating at switching frequencies well below 1 kHz, such as medium-voltage drives and modular multi-level converters. Consisting of two main parts, the first offers a detailed review of three-phase power electronics, electrical machines, carrier-based pulse width modulation, optimized pulse patterns, state-of-the art converter control methods and the principle of MPC. The second part is an in-depth treatment of MPC methods that fully exploit the performance potential of high-power converters. These control methods combine the fast control responses of deadbeat control with the optimal steady-state performance of optimized pulse patterns by resolving the antagonism between the two. MPC is expected to evolve into the control method of choice for power electronic systems operating at low pulse numbers with multiple coupled variables and tight operating constraints it. Model Predictive Control of High Power Converters and Industrial Drives will enable to reader to learn how to increase the power capability of the converter, lower the current distortions, reduce the filter size, achieve very fast transient responses and ensure the reliable operation within safe operating area constraints. Targeted at power electronic practitioners working on control-related aspects as well as control engineers, the material is intuitively accessible, and the mathematical formulations are augmented by illustrations, simple examples and a book companion website featuring animations. Readers benefit from a concise and comprehensive treatment of MPC for industrial power electronics, enabling them to understand, implement and advance the field of high-performance MPC schemes.

Converter-Based Dynamics and Control of Modern Power Systems addresses the ongoing changes and challenges in rotating masses of synchronous generators, which are transforming dynamics of the electrical system. These changes make it more important to consider and understand the role of power electronic systems and their characteristics in shaping the subtleties of the grid and this book fills that knowledge gap. Balancing theory, discussion, diagrams, mathematics, and data, this reference provides the information needed to acquire a thorough overview of resilience issues and frequency definition and estimation in modern power systems. This book offers an overview of classical power system dynamics and identifies ways of establishing future challenges and how they can be considered at a global level to overcome potential problems. The book is designed to prepare future engineers for operating a system that will be driven by electronics and less by electromechanical systems. Includes theory on the emerging topic of electrical grids based on power electronics Creates a good

bridge between traditional theory and modern theory to support researchers and engineers Links the two fields of power systems and power electronics in electrical engineering

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