

Control Of Power Inverters In Renewable Energy And Smart Grid Integration

Multilevel Inverters: Topologies, Control Methods, and Applications investigates modern device topologies, control methods, and application areas for the rapidly developing conversion technology. The device topologies section begins with conventional two-level inverter topologies to provide a background on the DC-AC power conversion process and required circuit configurations. Thereafter, multilevel topologies originating from neutral point clamped topologies are presented in detail. The improved and inherited regular multilevel topologies such as flying capacitor and conventional H-bridge topology are presented to illustrate the multilevel concept. Emerging topologies are introduced regarding application areas such as renewable energy sources, electric vehicles, and power systems. The book goes on to discuss fundamental operational principles of inverters using the conventional pulse width modulated control method. Current and voltage based closed loop control methods such as repetitive control, space vector modulation, proportional resonant control and other recent methods are developed. Core modern applications including wind energy, photovoltaics, microgrids, hybrid microgrids, electric vehicles, and power systems are investigated in depth. Multilevel Inverters for Emergent Topologies and Advanced Power Electronics Applications is a valuable resource for electrical engineering specialists, smart grid specialists, researchers on electrical, power systems, and electronics engineering, energy and computer engineers. Reviews mathematical modeling and step-by-step simulation examples, straddling both basic and advanced topologies Assesses how to systematically apply and control multilevel power inverters in application scenarios

Reviews key applications across wind energy, photovoltaics, microgrids, hybrid microgrids, electric vehicles, active filters, static VAR compensators This book is the result of the extensive experience the authors gained through their year-long occupation at the Faculty of Electrical Engineering at the University of Banja Luka. Starting at the fundamental basics of electrical engineering, the book guides the reader into this field and covers all the relevant types of converters and regulators. Understanding is enhanced by the given examples, exercises and solutions. Thus this book can be used as a textbook for students, for self-study or as a reference book for professionals.

This volume includes extended and revised versions of a set of selected papers from the International Conference on Electric and Electronics (EEIC 2011), held on June 20-22, 2011, which is jointly organized by Nanchang University, Springer, and IEEE IAS Nanchang Chapter. The objective of EEIC 2011 Volume 4 is to provide a major interdisciplinary forum for the presentation of new approaches from Communication Systems and Information Technology, to foster integration of the latest developments in scientific research. 137 related topic papers were selected into this volume. All the papers were reviewed by 2 program committee members and selected by the volume editor Prof. Ming Ma. We hope every participant can have a good opportunity to exchange their research ideas and results and to discuss the state of the art in the areas of the Communication Systems and Information Technology.

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

Model Predictive Control of High Power Converters and Industrial Drives

Modeling and Control of Power Electronic Converters for Microgrid Applications

Power Electronics-Enabled Autonomous Power Systems

Dynamics and Control in Conventional and Renewable Energy Applications

Smart Solar PV Inverters with Advanced Grid Support Functionalities

Understanding the fundamentals of smart photovoltaic (PV) inverter technology with this insightful one-stop resource Smart Solar PV Inverters with Advanced Grid Support Functionalities presents a comprehensive coverage of smart PV inverter technologies in alleviating grid integration challenges of solar PV systems and for additionally enhancing grid reliability. Accomplished author Rajiv Varma systematically integrates information from the wealth of knowledge on smart inverters available from EPRI, NREL, NERC, SIWG, EU-PPSEC, CIGRE, IEEE publications; and utility experiences worldwide. The book further presents a novel, author-developed and patented smart inverter technology for utilizing solar PV plants both in the night and day as a Flexible AC Transmission System (FACTS) Controller STATCOM, named PV-STATCOM. Replete with case studies, this book includes over 600 references and 280 illustrations. Smart Solar PV Inverters with Advanced Grid Support Functionalities' features include: Concepts of active and reactive power control; description of different smart inverter functions, and modeling of smart PV inverter systems Distribution system applications of PV-STATCOM for dynamic voltage control, enhancing connectivity of solar PV and wind farms, and stabilization of critical motors Transmission system applications of PV-STATCOM for improving power transfer capacity, power oscillation damping (POD), suppression of subsynchronous oscillations, mitigation of fault induced delayed voltage recovery (FIDVR), and fast frequency response (FFR) with POD Hosting capacity for solar PV systems, its enhancement through effective settings of different smart inverter functions; and control coordination of smart PV inverters Emerging smart inverter grid support functions and their pioneering field demonstrations worldwide, including Canada, USA, UK, Chile, and India. Perfect for system planners and system operators, utility engineers, inverter manufacturers and solar farm developers, this book will prove to be an important resource for academics and graduate students involved in electrical power and renewable energy systems.

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.

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.

Electric power systems are experiencing a paradigm shift in order to become cleaner, smarter, and more reliable. This edited book examines a wide range of topics related to these changes, which are primarily caused by the introduction of information technologies, renewable energy penetration, digitalized equipment, new operational strategies, and so forth. The emphasis will be put on the modeling and control of smart grid systems. The book addresses research topics such as high efficiency transformers, wind turbines and generators, fuel cells, or high speed turbines and generators.

Power Electronics and Motor Drive Systems

High-Power Converters and AC Drives

Control Methods and Advanced Power Electronic Applications

Power Electronic Converters for Microgrids

Second Edition

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 methods and control methods.

This book presents the reader, whether an electrical engineering student in power electronics or a design engineer, a selection of power converter control problems and their basic digital solutions, based on the most widespread digital control techniques. The presentation is primarily focused on different applications of the same power converter topology, the half-bridge voltage source inverter, considered both in its single- and three-phase implementation. This is chosen as the test case because, besides being simple and well known, it allows the discussion of a significant spectrum of the most frequently encountered digital control applications in power electronics, from digital pulse width modulation (DPWM) and space vector modulation (SVM), to inverter output current and voltage control, ending with the relatively more complex VSI applications related to the so called smart-grid scenario. This book aims to serve two purposes: (1) to give a basic, introductory knowledge of the digital control techniques applied to power converters; and (2) to raise the interest for discrete time control theory, stimulating new developments in its application to switching power converters.

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 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 electronics, control of power electronics, and renewable energy systems.

This book presents a novel control method for power converters, referred to as m-mode control. It provides an overview of traditional control methods for inverters - e.g. PWM and SVPWM - and the theory of the m-mode control method, while also discussing and applying m-mode control on various types of converters (including three-phase, nine-switch, five-leg and multi-level inverters, PWM rectifiers and modular multi-level converters). The book provides readers with sufficient background and understanding to delve deeper into the topic of SVPWM control. It is also a valuable guide for engineers and researchers whose work involves power converter control.

Power Electronics

Selected Papers from the 2011 International Conference on Electric and Electronics (EEIC 2011) in Nanchang, China on June 20-22, 2011, Volume 4

Communication Systems and Information Technology

Local Control of Autonomous Power Inverters in a Microgrid

Integration, Challenges and Optimization

DC/AC inversion technology is of vital importance for industrial applications, including electrical vehicles and renewable energy systems, which require a large number of inverters. In recent years, inversion technology has developed rapidly, with new topologies improving the power factor and increasing power efficiency. Proposing many novel approaches, Advanced DC/AC Inverters: Applications in Renewable Energy describes advanced DC/AC inverters that can be used for renewable energy systems. The book introduces more than 100 topologies of advanced inverters originally developed by the authors, including more than 50 new circuits. It also discusses recently published cutting-edge topologies. Novel PWM and Multilevel Inverters The book first covers traditional pulse-width-modulation (PWM) inverters before moving on to new quasi-impedance source inverters and soft-switching PWM inverters. It then examines multilevel DC/AC inverters, which have overcome the drawbacks of PWM inverters and provide greater scope for industrial applications. The authors propose four novel multilevel inverters: ladder multilevel inverters, super-lift modulated inverters, switched-capacitor inverters, and switched-inductor inverters. With simple structures and fewer components, these inverters are well suited for renewable energy systems. Get the Best Switching Angles for Any Multilevel Inverter A key topic for multilevel inverters is the need to manage the switching angles to obtain the lowest total harmonic distortion (THD). The authors outline four methods for finding the best switching angles and use simulation waveforms to verify the design. The optimum switching angles for multilevel DC/AC inverters are also listed in tables for quick reference. Application Examples of DC/AC Inverters in Renewable Energy Systems Highlighting the importance of inverters in improving energy saving and power-supply quality, the final chapter of the book supplies design examples for applications in wind turbine and solar panel energy systems. Written by pioneers in advanced conversion and inversion technology, this book guides readers in designing more effective DC/AC inverters for use in renewable energy systems.

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.

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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.

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Towards Smarter and Greener Electric Grids

Modeling and Control of Power Electronics Converter System for Power Quality Improvements

Control and Applications of Power Inverters Using Second-order Switching Surface

Control of Power Electronic Converters and Systems

APEC focuses on the practical and applied aspects of the power electronics business The conference addresses issues of immediate and long term importance to practicing power electronics engineer

Control in Power Electronics explores all aspects of the study and use of electronic integrated circuits for the control and conversion of electrical energy. This technology is a critical part of our energy infrastructure, and supports almost all important electrical applications and devices. Improvements in devices and advances in control concepts have led to steady improvements in power electronic applications. This is driving a tremendous expansion of their applications. Control in Power Electronics brings together a team of leading experts as contributors. This is the first book to thoroughly combine control methods and techniques for power electronic systems. The development of new semiconductor power components, new topologies of converters from one side coupled with advances in modern control theory and digital signal processors has made this book possible and presents the applications necessary for modern design engineers. The authors were originally brought together to share research and applications through the international Danfos Programme at Aalborg University in Denmark. ersonal computers would be unwieldy and inefficient without power electronic dc supplies. Portable communication devices and computers would also be impractical. High-performance lighting systems, motor controls, and a wide range of industrial controls depend on power electronics. In the near future we can expect strong growth in automotive applications, dc power supplies for communication systems, portable applications, and high-end converters. We are approaching a time when all electrical energy will be processed and controlled through power electronics somewhere in the path from generation to end use.

Understanding and controlling 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.

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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.

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 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

m-Mode SVPWM Technique for Power Converters

Grid Converters for Photovoltaic and Wind Power Systems

Control in Power Electronics

Advanced DC/AC Inverters

Multilevel Inverters