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*The book focuses on the integration
of intelligent communication systems,*

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control systems, and devices related to all aspects of engineering and sciences. It includes high-quality research papers from the 3rd international conference, ICICCD 2018, organized by the Department of Electronics, Instrumentation and

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*Control Engineering at the University
of Petroleum and Energy Studies,
Dehradun on 21–22 December 2018.
Covering a range of recent advances
in intelligent communication,
intelligent control and intelligent
devices., the book presents original*

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research and findings as well as researchers' and industrial practitioners' practical development experiences of.

This book includes original, peer-reviewed research papers from the 2020 International Top-Level Forum

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*on Engineering Science and
Technology Development Strategy --
the 5th PURPLE MOUNTAIN
FORUM on Smart Grid Protection
and Control(PMF2020), held in
Nanjing, China, on August 15-16,
2020. Hot topics and cutting edge*

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*technologies are included: - Advanced
Power Transmission Technology - AC-
DC Hybrid Power Grid Technology -
IoT Technology and Application -
Operation, Protection and Control of
Power Systems Supplied with High
Penetration of Renewable Energy*

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*Sources - Active Distribution Network
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Consumption and Energy-saving
Technology - New Technology on
Substation Automation - Clean
Energy Technology - Energy Storage
Technology and Application - Key*

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*Technology and Application of
Integrated Energy - Application of
AI, Block Chain, Big Data and Other
New Technologies in Energy Industry
- Application of New Information
and Communication Technology in
Energy Industry - Application of*

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*Technical Standard System and
Related Research in Energy Industry*

*The papers included in this
proceeding share the latest research
results and practical application
examples on the methodologies and
algorithms in these areas, which*

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*makes the book a valuable reference
for researchers, engineers, and
university students.*

*Model Predictive Control of Wind
Energy Conversion Systems addresses
the predicative control strategy that
has emerged as a promising digital*

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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

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*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*

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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-

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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

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*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-*

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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,

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*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,*

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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

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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

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advanced undergraduate courses.

*Model Predictive Control of High
Power Converters and Industrial
Drives*

*Analysis, Control, and Applications
Modeling and Control of Modular
Multilevel Converter Based on*

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*Ordinary Differential Equations and
Its Applications for HVDC System
Distribution Power Systems and
Power Quality
Proceedings of the 2nd International
Conference on Data Science,
Machine Learning and Applications*

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*Model Predictive Control of Wind
Energy Conversion Systems*

The 2014 International Conference
on Mechatronics Engineering and
Electrical Engineering
(CMEEE2014) was held October
18-19, 2014 in Sanya, Hainan,

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China. CMEEE2014 provided a valuable opportunity for researchers, scholars and scientists to exchange their new ideas and application experiences face to face together, to establish business or research

Nowadays the Modular Multilevel

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Cascaded Converter (MMCC) is a family of emerging high-voltage multilevel converters that are configured with a cascaded connection of identical submodules with low-voltage ratings by distinct topological structures. The MMCC

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system is featured with a high quantity of coupled system variables (converter currents and floating submodule voltages) and abundant discrete control inputs (submodule switching states). To guarantee a stable and optimal system operation,

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it is a fundamental challenge to fully model and control these variables.

This thesis addresses two frameworks for the control-oriented MMCC modeling as well as the hierarchical analysis. The first framework in Part I presents a

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comprehensive classification of MMCC topologies, analyzes them by replacing converter branches with continuous controllable voltage sources and develops a unified modeling procedure for current and branch energy, aiming for a general

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understand of MMCC in the context of continuous system theory. The second framework aims to develop an explicit relation between submodule switching states and MMCC system variables, which preserves the characteristics of

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discrete switched system. Two practical direct control methods, e.g., fast reduced control set and event-based method, are proposed, which achieves comparable harmonic performance and obviously improved submodule

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voltage balancing under the premise of the same switching frequency as the conventional submodule-voltage-sorting method.

This book collects a selection of papers presented at
ELECTRIMACS 2019, the 13th

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international conference of the IMACS TC1 Committee, held in Salerno, Italy, on 21st-23rd May 2019. The conference papers deal with modelling, simulation, analysis, control, power management, design optimization, identification and

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diagnostics in electrical power engineering. The main application fields include electric machines and electromagnetic devices, power electronics, transportation systems, smart grids, electric and hybrid vehicles, renewable energy systems,

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energy storage, batteries, supercapacitors and fuel cells, and wireless power transfer. The contributions included in Volume 1 are particularly focused on electrical engineering simulation aspects and innovative applications.

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Smart Grid and Enabling

Technologies

Low-Switching Frequency

Modulation Schemes for Multi-level

Inverters

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Engineering

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developments in switchgear
and DC/DC converters for DC
grids, and includes

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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

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the latest VSC HVDC based on
Modular Multilevel
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the principles of building
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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

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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

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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

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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

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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

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found in similar books,
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models and examples for all
HVDC topologies hosted by
the 1st edition companion
site. High Voltage Direct
Current Transmission:
Converters, Systems and DC

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Grids, 2nd Edition serves as an ideal textbook for a graduate-level course or a professional development course.

In this book, nine papers focusing on different fields of power electronics are

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gathered, all of which are in line with the present trends in research and industry. Given the generality of the Special Issue, the covered topics range from electrothermal models and losses models in

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semiconductors and magnetics to converters used in high-power applications. In this last case, the papers address specific problems such as the distortion due to zero-current detection or fault investigation using

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the fast Fourier transform,
all being focused on
analyzing the topologies of
high-power high-density
applications, such as the
dual active bridge or the H-
bridge multilevel inverter.
All the papers provide

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enough insight in the analyzed issues to be used as the starting point of any research. Experimental or simulation results are presented to validate and help with the understanding of the proposed ideas. To

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summarize, this book will help the reader to solve specific problems in industrial equipment or to increase their knowledge in specific fields.

The renewable generation system is currently

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experiencing rapid growth in various power grids. The stability and dynamic response issues of power grids are receiving attention due to the increase in power electronics-based renewable

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energy. The main focus of this Special Issue is to provide solutions for power system planning and operation. Power electronics-based devices can offer new ancillary services to several industrial sectors.

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In order to fully include the capability of power conversion systems in the network integration of renewable generators, several studies should be carried out, including detailed studies of

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switching circuits, and comprehensive operating strategies for numerous devices, consisting of large-scale renewable generation clusters.

Design, Modeling and Control
of Modular Multilevel

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Control And

Converter Based HVDC Systems

Modeling, Operation, and

Analysis of DC Grids

Intelligent Communication,

Control and Devices

Sustainable Energy for Smart

Cities

Hvdc Transmission +1: Vsc

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Hvdc Based Mmc Topology In
Power Systems
Design and Control of Power
Converters 2019

*This work addresses problems
that arise with the application
of Model Predictive Control*

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(MPC) to Modular Multilevel Converters (MMCs), by aiming to reduce the complexity of the optimization problem associated with the controller while properly tracking the converter states. Due to the

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*complexity of the MMC,
principally attributed to the
high dimension of its state
space model along with the
high number of discontinuous
switching variables available,
solving the optimization*

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problem associated with the MPC can be challenging. This becomes more significant when long prediction horizons are required. In order to address this problem, this work presents a reduced order

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model that aims to reduce the complexity of the state space model of the MMC and to eliminate the discontinuities associated with the converter switches. In order to validate this approach, the accuracy

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and limitations of this model are analyzed and identified in detail. Moreover, with the help of the reduced order model, detailed references for the MMC are carefully designed and, for the case presented in

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this work, reference parameters are selected optimally in order to reduce the voltage ripple in the converter modules. The complexity of the optimization problem associated with the

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MPC is also reduced with the help of the reduced order model by considering just one continuous control signal per converter arm. To further aid the optimization, a method to derive conditions that

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guarantee its convexity is presented. By guaranteeing convexity, it is possible to use very well studied and efficient optimization algorithms, easing the application of MPC on MMC, especially in the case

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*where long prediction horizons are required. In order to illustrate the proposed procedure, numerical examples are presented in a simulation environment. ; eng
Multi-level Inverters (MLIs)*

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are widely used for conversion of DC to AC power. This book provides various low-switching frequency (LSF) modulation schemes (conventional and improved), which can be implemented on MLIs. The

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LSF modulation schemes are implemented to three different MLI topologies to demonstrate their working and aimed at their application to reader invented MLI topologies. Highlighting the advantages of

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LSF over high-switching frequency (HSF) modulation schemes, the simulations are carried out using MATLAB®/Simulink along with hardware experiments. The practical application of

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MLIs to renewable energy sources and electric vehicles is also provided at the end of the book. Aimed at researchers, graduate students in Electric Power Engineering, Power Electronics, this book:

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Presents detailed overview of most commonly used multi-level inverter topologies. Covers advantages of low-switching over high-switching frequency scheme. Includes an exclusive section dedicated for

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an improved low-switching modulation scheme. Dedicated chapter on application of renewable energy sources to multi-level invertors and electric vehicles. Explains all the low-switching frequency

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Discover foundational topics in smart grid technology as well as an exploration of the current and future state of the industry As the relationship between fossil fuel use and

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climate change becomes ever clearer, the search is on for reliable, renewable and less harmful sources of energy. Sometimes called the electronet or the energy Internet, smart grids promise

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*to integrate renewable energy,
information, and
communication technologies
with the existing electrical
grid and deliver electricity
more efficiently and reliably.
Smart Grid and Enabling*

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Technologies delivers a complete vision of smart grid technology and applications, including foundational and fundamental technologies, the technology that enables smart grids, the current state of the

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industry, and future trends in smart energy. The book offers readers thorough discussions of modern smart grid technology, including advanced metering infrastructure, net zero energy

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buildings, and communication, data management, and networks in smart grids. The accomplished authors also discuss critical challenges and barriers facing the smart grid industry as well as trends

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likely to be of import in its future development. Readers will also benefit from the inclusion of: A thorough introduction to smart grid architecture, including traditional grids, the

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fundamentals of electric power, definitions and classifications of smart grids, and the components of smart grid technology An exploration of the opportunities and challenges posed by renewable

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*energy integration Practical
discussions of power
electronics in the smart grid,
including power electronics
converters for distributed
generation, flexible alternating
current transmission systems,*

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*and high voltage direct current
transmission systems An
analysis of distributed
generation Perfect for
scientists, researchers,
engineers, graduate students,
and senior undergraduate*

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students studying and working with electrical power systems and communication systems. Smart Grid and Enabling Technologies will also earn a place in the libraries of economists, government

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planners and regulators, policy makers, and energy stakeholders working in the smart grid field.

Investigation of Modulation Dynamics and Control of Modular Multilevel Converter

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*for High Voltage DC Grids
Modular Multilevel Converters
Proceedings of the 2014
International Conference on
Mechatronics Engineering and
Electrical Engineering
(CMEEE 2014), Sanya,*

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Hainan, P.R. China, 17-19

October 2014

*Advanced Technologies for
Modeling, Optimization and
Control of the Future*

Distribution Grid

Multilevel Converters: Control

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*Techniques for Renewable
Energy Resources*

Design, Control, and

Application of Modular

Multilevel Converters for

HVDC Transmission Systems

This book is a collection of

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scientific papers concerning multilevel inverters examined from different points of view. Many applications are considered, such as renewable energy interface, power conditioning systems, electric drives, and chargers for electric

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vehicles. Different topologies have been examined in both new configurations and well-established structures, introducing novel and particular modulation strategies, and examining the effect of modulation techniques on voltage and current

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harmonics and the total harmonic distortion.

Continuous cost reduction of photovoltaic (PV) systems and the rise of power auctions resulted in the establishment of PV power not only as a green energy source but also as

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a cost-effective solution to the
electricity generation market.

Various commercial solutions for
grid-connected PV systems are
available at any power level, ranging
from multi-megawatt utility-scale
solar farms to sub-kilowatt

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residential PV installations.

Compared to utility-scale systems, the feasibility of small-scale residential PV installations is still limited by existing technologies that have not yet properly address issues like operation in weak grids, opaque

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and partial shading, etc. New market drivers such as warranty improvement to match the PV module lifespan, operation voltage range extension for application flexibility, and embedded energy storage for load shifting have again

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put small-scale PV systems in the spotlight. This Special Issue collects the latest developments in the field of power electronic converter topologies, control, design, and optimization for better energy yield, power conversion efficiency,

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reliability, and longer lifetime of the small-scale PV systems. This Special Issue will serve as a reference and update for academics, researchers, and practicing engineers to inspire new research and developments that pave the way for

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next-generation PV systems for residential and small commercial applications.

Control of Power Electronic Converters, Volume Two gives the theory behind power electronic converter control and discusses the

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operation, modelling and control of basic converters. The main components of power electronics systems that produce a desired effect (energy conversion, robot motion, etc.) by controlling system variables (voltages and currents) are

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thoroughly covered. Both small (mobile phones, computer power supplies) and very large systems (trains, wind turbines, high voltage power lines) and their power ranges, from the Watt to the Gigawatt, are presented and explored. Users will

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find a focused resource on how to apply innovative control techniques for power converters and drives.

Discusses different applications and their control Explains the most important controller design methods, both in analog and digital Describes

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different, but important, applications
that can be used in future industrial
products Covers voltage source
converters in significant detail
Demonstrates applications across a
much broader context
Modelling and Control of a Grid-

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connected Full Bridge Modular
Multilevel Converter for Integration
of Wind Energy Conversion
Systems

Multilevel Converters: Analysis,
Modulation, Topologies, and
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Photovoltaic Systems

High Voltage Direct Current
Transmission

Proceedings of 2020 International
Top-Level Forum on Engineering

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Science and Technology

Development Strategy and The 5th
PURPLE MOUNTAIN FORUM
(PMF2020)

Transient Analysis of Power
Systems

This book comprises select

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papers from the international conference on Research in Intelligent and Computing in Engineering (RICE 2019) held at Hanoi University of Industry, Hanoi, Vietnam. The volume focuses on current research on

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various computing models such as centralized, distributed, cluster, grid and cloud. The contents cover recent advances in wireless sensor networks, mobile ad hoc networks, internet of things, machine learning, grid

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and cloud computing, and their various applications. The book will help researchers as well as professionals to gain insight into the rapidly evolving fields of internet computing and data mining.

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Multilevel Inverters: Topologies, Control Methods, and Applications investigates modern device topologies, control methods, and application areas for the rapidly developing conversion technology. The

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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

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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

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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

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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

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vector modulation, proportional resonant control and other recent methods are developed. Core modern applications including wind energy, photovoltaics, microgrids, hybrid microgrids, electric vehicles,

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active filters, and static VAR compensators are investigated in depth. Multilevel Inverters for Emergent Topologies and Advanced Power Electronics Applications is a valuable resource for electrical

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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

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***examples, straddling both basic
and advanced topologies***

***Assesses how to systematically
deploy and control multilevel
power inverters in application
scenarios Reviews key
applications across wind energy,***

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***photovoltaics, microgrids, hybrid
microgrids, electric vehicles,
active filters, static VAR
compensators
Unified Power Flow Controller
Technology and Application
provides comprehensive***

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coverage on UPFC technology, providing a range of topics, including design principle, control and protection, and insulation coordination. It summarizes all the most up-to-date research and practical

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achievements that are related to UPFC and MMC technology, including test techniques for main components, closed-loop test techniques for control and protection systems, and onsite techniques for implementing

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UPFC projects. The book is an essential reference book for both academics and engineers working in power system protection control, power system planning engineers, and HVDC FACTS related areas. Readers

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will not only obtain the detailed information regarding theoretical analysis and practical application of UPFC, but also the control mechanism of advanced MMC technology, both of which are not common topics in

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***previously published books.
Shows how to use modular
multilevel converters (MMC) to
implement UPFC that lead to
cost-effective and reliable
systems Draws from the most up-
to-date research and practical***

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***applications Teaches electromec
hanical/electromagnetic transient
simulation techniques and real-
time closed-loop simulation test
techniques of the MMC based
UPFC
Mechatronics Engineering and***

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***Electrical Engineering
Proceedings of ICICCD 2018
Solution Techniques, Tools and
Applications
Select Proceedings of RICE 2019
Advances in Automation, Signal
Processing, Instrumentation, and***

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***A Contribution to Modeling and
Control of Modular Multilevel
Cascaded Converter (MMCC)***

Design, Control and
Application of Modular
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HVDC Transmission Systems is a comprehensive guide to semiconductor technologies applicable for MMC design, component sizing control, modulation, and application of the MMC technology for HVDC

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transmission. Separated into three distinct parts, the first offers an overview of MMC technology, including information on converter component sizing, Control and Communication, Protection

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and Fault Management, and
Generic Modelling and
Simulation. The second covers
the applications of MMC in
offshore WPP, including
planning, technical and
economic requirements and

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optimization options, fault management, dynamic and transient stability. Finally, the third chapter explores the applications of MMC in HVDC transmission and Multi Terminal configurations,

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including Supergrids. Key features: Unique coverage of the offshore application and optimization of MMC-HVDC schemes for the export of offshore wind energy to the mainland. Comprehensive

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explanation of MMC
application in HVDC and MTDC
transmission technology.
Detailed description of MMC
components, control and
modulation, different modeling
approaches, converter

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dynamics under steady-state and fault contingencies including application and housing of MMC in HVDC schemes for onshore and offshore. Analysis of DC fault detection and protection

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technologies, system studies required for the integration of HVDC terminals to offshore wind power plants, and commissioning procedures for onshore and offshore HVDC terminals. A set of self-

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explanatory simulation models for HVDC test cases is available to download from the companion website. This book provides essential reading for graduate students and researchers, as well as field

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engineers and professionals who require an in-depth understanding of MMC technology.

This book presents the select proceedings of the International Conference on

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Automation, Signal
Processing, Instrumentation
and Control (i-CASIC) 2020.
The book mainly focuses on
emerging technologies in
electrical systems, IoT-based
instrumentation, advanced

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industrial automation, and advanced image and signal processing. It also includes studies on the analysis, design and implementation of instrumentation systems, and high-accuracy and energy-

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efficient controllers. The contents of this book will be useful for beginners, researchers as well as professionals interested in instrumentation and control, and other allied fields.

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In der Energietechnik wächst die Verwendung von Umrichtern durch den Einsatz regenerativer Energien. Besonders Photovoltaik- und Windkraftanlagen benötigen Umrichter zur Einspeisung

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von elektrischer Energie in
das Versorgungsnetz. Die Hoch-
spannungs-Gleichstrom-
Übertragung (HGU) gewinnt
dabei zunehmend an
Bedeutung. In dieser
Dissertation werden Strategien

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und Verfahren zur Regelung von Modulare Multilevel Umrichtern (MMC) am Beispiel der HGU vorgestellt. Die gezeigten Methoden werden verstärkt aus regelungstechnischer Sicht

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entwickelt und erläutert. Diese Sichtweise stellt eine weitgehend neuartige Herangehensweise für eine Aufgabe dar, welche heutzutage meist mit gängigen Methoden aus der

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Energietechnik gelöst wird. Es wird eine erweiterte Mehrgrossenregelstrategie für MMCs vorgeschlagen, die im Vergleich zu bisherigen Technologien die erhöhte Anzahl an Regelungszielen

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berücksichtigt und den
höheren Freiheitsgrad eines
MMC-Systems einbezieht.
Hierzu werden
Zustandsraummodelle und
Reglerentwurfsverfahren
entwickelt und die

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praxisrelevanten Themen
Stell- und Messtotzeiten,
stationäre Genauigkeit,
Regelung von Mit-, Gegen-,
und Nullsystemströmen und
unerwünschte harmonischer
Oberschwingungen

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untersucht. Zur besseren Vorstellung des gesamten Systemverhaltens werden Simulationen von Netzfehlerfällen gezeigt, welche die Effektivität und Effizienz der entwickelten

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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

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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

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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

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modular multilevel converters employed in motor drives, HVDC systems, and power quality improvement. Modular Multilevel Converters: Analysis, Control, and Applications provides an

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overview of high-power converters, reference frame theory, classical control methods, pulse width modulation schemes, advanced model predictive control methods, modeling of ac

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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,

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modeling and control of static synchronous compensators (STATCOM) and unified power quality compensators.

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various modular multilevel converters in a wide range of applications such as transformer and transformerless motor drives, high voltage direct current transmission systems, and

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Reflects the latest
developments in high-power
converters in medium-voltage
motor drive systems Offers
design guidance with tables,
charts graphs, and MATLAB

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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

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high power converters. It also serves well as a textbook for graduate-level students.

High penetration of fluctuating renewable power units, such as wind turbines and photovoltaic systems, and new

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heavy loads, such as electrical vehicles and heat pumps, which so far might not be controlled according to the actual distribution grid condition, but rather according to actual

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consumption of the devices, influences the distribution grid in several ways, and it may lead to voltage disturbances, frequency deviations and harmonic content beyond limits. Over voltages might be

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generated at power production which is too high, whereas under voltage might occur at heavy load situations; both phenomena might be seen at the same distribution radial, where harmonic injections can

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also come from the devices, if equipped with power converters. This has led to the main target object for this book being power quality in distribution grids. This book offers 10 papers regarding

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power quality issues at distribution grids. It looks into hosting capacity issues, stability analysis, reliability assessment, mitigation of voltage rise using reactor installation, power quality

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assessments, harmonic analysis and damping, frequency control in weak and isolated power systems, and the focus is therefore broad within the overall topic of power quality.

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This book gathers selected high-impact articles from the 2nd International Conference on Data Science, Machine Learning & Applications 2020. It highlights the latest developments in the areas of

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artificial intelligence, machine learning, soft computing, human-computer interaction and various data science and machine learning applications. It brings together scientists and researchers from different

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From High Power DC
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in Renewable Energy Systems
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HVDC grids and super grids have sparked so much interest these days that researchers and engineers across the globe are talking about

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them, studying them, supporting them, or questioning them. This book provides valuable information for researchers, industry, and policy makers. It explains why HVDC is favorable over AC technologies for power

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transmission; what the key technologies and challenges are for developing an HVDC grid; how an HVDC grid will be designed and operated; and how future HVDC grids will evolve. The book also devotes significant attention to

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nontechnical aspects such as the influence of energy policy and regulatory frameworks. This book is a result of collaboration between industry and academia. It provides theoretical insights into the design and control of MMC technology

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and investigates practical aspects of the project planning, design, manufacture, implementation, and commissioning of MMC-HVDC and multi-terminal HVDC transmission technologies; filling the knowledge gap between the

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technology specialists and VSC-HVDC project developers and key personnel involved in those projects.

"High-voltage direct current (HVDC) system is more efficient than high-voltage alternating current (HVAC) system for long-

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distance, bulk power transmission. Modularity, flexibility, reliability and high efficiency make the modular multilevel converter (MMC) the topology of choice in HVDC applications. Because the increasing number of installations

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shows that the MMC-HVDC is the HVDC of the future, this thesis is continuing research to advance the capability of the MMC-HVDC. This thesis focuses on fast simulation capability and control strategies for the MMC-HVDC. The main

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objectives are: (1) to develop a fast and accurate simulation model of a single MMC station and models of multi-terminal MMC-HVDC stations (MTDC-MMC); (2) to investigate the method to design proper parameters for high

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damping; (3) to design the MMC-HVDC with the capability of power oscillation damping (POD).

Simulation is computation-intensive in MMC. The thesis develops a fast and accurate method by which an MMC station is modeled by

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ordinary differential equations (ODE). The proposed MMC ODE model is implemented in MATLAB SIMULINK and its correctness is validated by the MMC Detail Equivalent Model (DEM) in RT-LAB. Taking advantage of its speed

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*and accuracy, a Four-Terminal
MMC-HVDC system based on the
MMC ODE model is developed. The
ODE model meets the speed and
accuracy requirements of power
systems engineers who are
concerned with planning, operation*

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and protection studies. As the ordinary differential equations are nonlinear, small perturbation about a steady-state is applied to obtain the linearized time-periodic matrix. The steady-state takes a long time to simulate because it depends on the

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transients to have all damped out. The method of Aprille and Trick is applied. Simulation converges to the steady-state in one cycle of 50 Hz. The resultant linearized matrix is time-periodic. The Floquet-Lyapunov Theorem is applied to

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construct the state-transition matrix from the linearized time-periodic matrix. The eigenvalues of the state-transition matrix contain the coefficients of damping. Graphs of damping coefficients plotted against different sizes of circuit

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parameters are displayed to assist designers in realizing high damping. The thesis looks for opportunities to add value to the MMC-HVDC. The active power transmissibility of AC transmission lines is limited by the transient

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stability limit which is significantly below the thermal limit. Extensive research and development have been pursued to increase the transient stability limit by flexible AC transmissions system (FACTS). This thesis seeks to use the MMC-

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*HVDC to operate as power
oscillation damper to increase the
power transmissibility. The thesis
looks for opportunities to integrate
previously proven control methods
into a common universal control.
The Universal Controller brings*

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together the deadbeat control, the circulating current suppression control (CCSC), the POD and the decoupled P-Q strategy in the control of the MMC-HVDC station by the MMC ODE model. Deadbeat control enables the MMC to survive

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*destructively large AC fault
currents to improve the transient
stability of AC grids"--*

*Modeling, Operation, and Analysis
of DC Grids presents a unified
vision of direct current grids with
their core analysis techniques,*

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uniting power electronics, power systems, and multiple scales of applications. Part one presents high power applications such as HVDC transmission for wind energy, faults and protections in HVDC lines, stability analysis and inertia

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emulation. The second part addresses current applications in low voltage such as microgrids, power trains and aircraft applications. All chapters are self-contained with numerical and experimental analysis. Provides a

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*unified, coherent presentation of
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Modularen Multilevel-Umrichters*

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als Antriebsumrichter fuer

Drehstrommaschinen

In this book, 20 papers
focused on different
fields of power
electronics are gathered.
Approximately half of the

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papers are focused on different control issues and techniques, ranging from the computer-aided design of digital compensators to more specific approaches such

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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

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are applied are varied:

MMCs, photovoltaic systems, supercapacitors and traction systems, LEDs, wireless power transfer, etc.

The comprehensive and

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authoritative guide to
power electronics in
renewable energy systems
Power electronics plays a
significant role in modern
industrial automation and
high- efficiency energy

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systems. With contributions from an international group of noted experts, Power Electronics in Renewable Energy Systems and Smart Grid: Technology and

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Applications offers a comprehensive review of the technology and applications of power electronics in renewable energy systems and smart grids. The authors cover

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information on a variety of energy systems including wind, solar, ocean, and geothermal energy systems as well as fuel cell systems and bulk energy storage systems.

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They also examine smart grid elements, modeling, simulation, control, and AI applications. The book's twelve chapters offer an application-oriented and tutorial

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viewpoint and also contain technology status review. In addition, the book contains illustrative examples of applications and discussions of future perspectives. This

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important resource:

Includes descriptions of power semiconductor devices, two level and multilevel converters, HVDC systems, FACTS, and more Offers discussions on

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various energy systems
such as wind, solar,
ocean, and geothermal
energy systems, and also
fuel cell systems and bulk
energy storage systems
Explores smart grid

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elements, modeling,
simulation, control, and
AI applications Contains
state-of-the-art
technologies and future
perspectives Provides the
expertise of international

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authorities in the field
Written for graduate
students, professors in
power electronics, and
industry engineers, Power
Electronics in Renewable
Energy Systems and Smart

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Grid: Technology and Applications offers an up-to-date guide to technology and applications of a wide-range of power electronics in energy systems and

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In this original book on model predictive control (MPC) for power electronics, the focus is put on high-power applications with

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multilevel converters operating at switching frequencies well below 1 kHz, such as medium-voltage drives and modular multi-level converters. Consisting of two main

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parts, the first offers a detailed review of three-phase power electronics, electrical machines, carrier-based pulse width modulation, optimized pulse patterns, state-of-

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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

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converters. These control methods combine the fast control responses of deadbeat control with the optimal steady-state performance of optimized pulse patterns by

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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

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numbers with multiple coupled variables and tight operating constraints it. Model Predictive Control of High Power Converters and Industrial Drives will

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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

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transient responses and ensure the reliable operation within safe operating area constraints. Targeted at power electronic practitioners working on

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control-related aspects as well as control engineers, the material is intuitively accessible, and the mathematical formulations are augmented by illustrations, simple

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Readers benefit from a
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electronics, enabling them to understand, implement and advance the field of high-performance MPC schemes.