Control Of Distributed Generation And Storage Operation

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POLLARD KNOX

Design of Novel Control Algorithms of Power Converters for Distributed Generation John Wiley & Sons
Featuring contributions from worldwide leaders in the field, the carefully crafted Electric Power Generation, Transmission, and Distribution, Third Edition (part of the five-volume set, The Electric Power Engineering Handbook) provides convenient access to detailed information on a diverse array of power engineering topics. Updates to nearly every chapter keep this book at the forefront of developments in modern power systems, reflecting international standards, practices, and technologies. Topics covered include: Electric power generation: nonconventional methods Electric power generation: conventional methods Transmission system Distribution systems Electric power utilization Power quality L.L. Grigsby, a respected and accomplished authority in power engineering, and section editors Saifur Rahman, Rama Ramakumar, George Karady, Bill Kersting, Andrew Hanson, and Mark Halpin present substantially new and revised material, giving readers up-to-date information on core areas. These include advanced energy technologies, distributed utilities, load characterization and modeling, and power quality issues such as power system harmonics, voltage sags, and power quality monitoring. With six new and 16 fully revised chapters, the book supplies a high level of detail and, more importantly, a tutorial style of writing and use of photographs and graphics to help the reader understand the material. New chapters cover: Water Transmission Line Reliability Methods High Voltage Direct Current Transmission System Advanced Technology High-Temperature Conduction Distribution Short-Circuit Protection Linear Electric Motors A volume in the Electric Power Engineering Handbook, Third Edition. Other volumes in the set: K12648 Power Systems, Third Edition (ISBN: 9781439856338) K13917 Power System Stability and Control, Third Edition (ISBN: 9781439883204) K12650 Electric Power Substations Engineering, Third Edition (ISBN: 9781439856383) K12643 Electric Power Transformer Engineering, Third Edition (ISBN: 9781439856291)
Communication and Control in Electric Power Systems Springer
This book features extensive coverage of all Distributed Energy Generation technologies, highlighting the technical, environmental and economic aspects of distributed resource integration, such as line loss reduction, protection, control, storage, power electronics, reliability improvement, and voltage profile optimization. It explains how electric power system planners, developers, operators, designers, regulators and policy makers can derive many benefits with increased penetration of distributed generation units into smart distribution networks. It further demonstrates how to best realize these benefits via skillful integration of distributed energy sources, based upon an understanding of the characteristics of loads and network configuration.
High Performance Control of Inverter Interfaced Distributed Generation BoD – Books on Demand
Go in-depth with this comprehensive discussion of distributed energy management Distributed Energy Management of Electrical Power Systems provides the most complete analysis of fully distributed control approaches and their applications for electric power systems available today. Authored by four respected leaders in the field, the book covers the technical aspects of control, operation management, and optimization of electric power systems. In each chapter, the book covers the foundations and fundamentals of the topic under discussion. It then moves on to more advanced applications. Topics reviewed in the book include: System-level coordinated control Optimization of active and reactive power in power grids The coordinated control of distributed generation, elastic load and energy storage systems Distributed Energy Management incorporates discussions of emerging and future technologies and their potential effects on electrical power systems. The increased impact of renewable energy sources is also covered. Perfect for industry practitioners and graduate students in the field of power systems, Distributed Energy Management remains the leading reference for anyone with an interest in its fascinating subject matter.
Energy Management of Distributed Generation Systems CRC Press
Distributed generation systems (DGs) have been penetrating into our energy networks with the advancement in the renewable energy sources and energy storage elements. These systems can operate in synchronism with the utility grid referred to as the grid connected (GC) mode of operation, or work independently, referred to as the standalone (SA) mode of operation. There is a need to ensure continuous power flow during transition between GC and SA modes, referred to as the transition mode, in operating DGs. In this dissertation, efficient and effective transition control algorithms are developed for DGs operating either independently or collectively with other units. Three techniques are proposed in this dissertation to manage the proper transition operations. In the first technique, a new control algorithm is proposed for an independent DG which can operate in SA and GC modes. The proposed transition control algorithm ensures low total harmonic distortion (THD) and less voltage fluctuation during mode transitions compared to the other techniques. In the second technique, a transition control is suggested for a collective of DGs operating in a microgrid system architecture to improve the reliability of the system, reduce the cost, and provide better performance. In this technique, one of the DGs in a microgrid system, referred to as a dispatch unit, takes the additional responsibility of mode transitioning to ensure smooth transition and supply/demand balance in the

microgrid. In the third technique, an alternative transition technique is proposed through hybridizing the current and droop controllers. The proposed hybrid transition control technique has higher reliability compared to the dispatch unit concept. During the GC mode, the proposed hybrid controller uses current control. During the SA mode, the hybrid controller uses droop control. During the transition mode, both of the controllers participate in formulating the inverter output voltage but with different weights or coefficients. Voltage source inverters interfacing the DGs as well as the proposed transition control algorithms have been modeled to analyze the stability of the algorithms in different configurations. The performances of the proposed algorithms are verified through simulation and experimental studies. It has been found that the proposed control techniques can provide smooth power flow to the local loads during the GC, SA and transition modes.

Competitive Power Control of Distributed Power Plants Butterworth-Heinemann
The integration of new sources of energy like wind power, solar-power, small-scale generation, or combined heat and power in the power grid is something that impacts a lot of stakeholders: network companies (both distribution and transmission), the owners and operators of the DG units, other end-users of the power grid (including normal consumers like you and me) and not in the least policy makers and regulators. There is a lot of misunderstanding about the impact of DG on the power grid, with one side (including mainly some but certainly not all, network companies) claiming that the lights will go out soon, whereas the other side (including some DG operators and large parks of the general public) claiming that there is nothing to worry about and that it's all a conspiracy of the large production companies that want to protect their own interests and keep the electricity price high. The authors are of the strong opinion that this is NOT the way one should approach such an important subject as the integration of new, more environmentally friendly, sources of energy in the power grid. With this book the authors aim to bring some clarity to the debate allowing all stakeholders together to move to a solution. This book will introduce systematic and transparent methods for quantifying the impact of DG on the power grid.

Distributed Energy Management of Electrical Power Systems Academic Press
Integration of Distributed Energy Resources in Power Systems: Implementation, Operation and Control covers the operation of power transmission and distribution systems and their growing difficulty as the share of renewable energy sources in the world's energy mix grows and the proliferation trend of small scale power generation becomes a reality. The book gives students at the graduate level, as well as researchers and power engineering professionals, an understanding of the key issues necessary for the development of such strategies. It explores the most relevant topics, with a special focus on transmission and distribution areas. Subjects such as voltage control, AC and DC microgrids, and power electronics are explored in detail for all sources, while not neglecting the specific challenges posed by the most used variable renewable energy sources. Presents the most relevant aspects of the integration of distributed energy into power systems, with special focus on the challenges for transmission and distribution Explores the state-of the-art in applications of the most current technology, giving readers a clear roadmap Deals with the technical and economic features of distributed energy resources and discusses their business models

Analysis, control and testing of inverter-based distributed generation in standalone and grid-connected applications John Wiley & Sons
The book presents the latest power conversion and control technology in modern wind energy systems. It has nine chapters, covering technology overview and market survey, electric generators and modeling, power converters and modulation techniques, wind turbine characteristics and configurations, and control schemes for fixed- and variable-speed wind energy systems. The book also provides in-depth steady-state and dynamic analysis of squirrel cage induction generator, doubly fed induction generator, and synchronous generator based wind energy systems. To illustrate the key concepts and help the reader tackle real-world issues, the book contains more than 30 case studies and 100 solved problems in addition to simulations and experiments. The book serves as a comprehensive reference for academic researchers and practicing engineers. It can also be used as a textbook for graduate students and final year undergraduate students.

Remote Control of Distributed Generation System John Wiley & Sons
Integrating renewable energy and other distributed energysources into smart grids, often via power inverters, is arguablythe largest "new frontier" for smart grid advancements.Inverters should be controlled properly so that their integrationdoes not jeopardize the stability and performance of power systemsand a solid technical backbone is formed to facilitate otherfunctions and services of smart grids. This unique reference offers systematic treatment of importantcontrol problems in power inverters, and different generalconverter theories. Starting at a basic level, it presentsconventional power conversion methodologies and then'non-conventional' methods, with a highly accessiblesummary of the latest developments in power inverters as well asinsight into the grid connection of renewable power. Consisting of four parts – Power Quality Control, NeutralLine Provision, Power Flow Control, and Synchronisation –this book fully demonstrates the integration of control and powerelectronics. Key features include: the fundamentals of power processing and hardware design innovative control strategies to systematically treat thecontrol of power inverters extensive experimental results for most of the controlstrategies presented the pioneering work on "synchronverters" which hasgained IET Highly Commended Innovation Award Engineers working on inverter design and those at power systemutilities can learn how advanced control strategies could improvesystem performance and work in practice. The book is a usefulreference for researchers who are interested in the area of controlengineering, power electronics, renewable energy and distributedgeneration, smart grids, flexible AC transmission systems, andpower systems for more-electric aircraft and all-electric ships.This is also a handy text for graduate students and universityprofessors in the areas of electrical power engineering, advancedcontrol engineering, power electronics, renewable energy and smartgrid integration.

Control of Power Inverters in Renewable Energy and Smart Grid Integration John Wiley & Sons
This book systematically discusses (a) Distributed Generation (DG), which operates in a single, stand-alone controllable system mode, and (b) the Microgrid (MG) powered by DG, along with the technical concepts, the impact on power systems, control and optimisation techniques, and their applications. It includes ten chapters that focus on the following five aspects: 1) An overview of distributed generation is introduced in

Chapter One, and the technical concept of the microgrid is introduced in Chapter Eight with detail; 2) As the main element of distributed generation (DG), a smart inverter system for the control of active and reactive power in a grid-tied mode, which is treated as an interface between grid and the RES (Renewable Energy System), is studied concretely in Chapter Two; 3) The influence of distributed generation on power systems, including the impact of DG on the planning and operation of power systems, the impact of DG on power quality, and power system protection are concretely described and analysed in Chapters Three, Four and Five, respectively;) The control and optimisation technologies for DG and MG. These techniques include: the Economic Model Predictive Control (EMPC) strategy for the solution of pricing management in community-based microgrids (MGs), which consider economic benefits as the control and optimisation objects; the distributed control and optimisation techniques for islanded microgrids (MGs) that consider stability as the control and optimisation objects; the intelligent load shedding for stability enhancement in an autonomous microgrid; and the recovery (restoration) control after a contingency situation. These are all investigated in Chapters Six, Seven, Eight and Nine, respectively; 5) The applications of renewable energy technology, such as efficient artisanal light fishing technologies that exploit lake light physics and light-fish interactions, are specifically presented in Chapter Ten.

Integration of Distributed Energy Resources in Power Systems John Wiley & Sons

Distributed Energy Resources in Microgrids: Integration, Challenges and Optimization unifies classically unconnected aspects of microgrids by considering them alongside economic analysis and stability testing. In addition, the book presents well-founded mathematical analyses on how to technically and economically optimize microgrids via distributed energy resource integration. Researchers and engineers in the power and energy sector will find this information useful for combined scientific and economical approaches to microgrid integration. Specific sections cover microgrid performance, including key technical elements, such as control design, stability analysis, power quality, reliability and resiliency in microgrid operation. Addresses the challenges related to the integration of renewable energy resources Includes examples of control algorithms adopted during integration Presents detailed methods of optimization to enhance successful integration

Modeling and Control of Fuel Cells CRC Press

This book provides the insight of various topology and control algorithms used for power control in distributed energy power conversion systems such as solar, wind, and other power sources. It covers traditional and advanced control algorithms of power filtering including modelling and simulations, and hybrid power generation systems. The adaptive control, model predictive control, fuzzy-based controllers, Artificial Intelligence-based control algorithm, and optimization techniques application for estimating the error regulator gains are discussed. Features of this book include the following: Covers the schemes for power quality enhancement, and voltage and frequency control. Provides complete mathematical modelling and simulation results of the various configurations of the renewable energy-based distribution systems. Includes design, control, and experimental results. Discusses mathematical modelling of classical and adaptive control techniques. Explores recent application of control algorithm and power conversion. This book is aimed at researchers, professionals, and graduate students in power electronics, distributed power generation systems, control engineering, Artificial Intelligent-based control algorithms, optimization techniques, and renewable energy systems.

Integration of Distributed Generation in the Power System John Wiley & Sons

This text is an introduction to the use of control in distributed power generation. It shows the reader how reliable control can be achieved so as to realize the potential of small networks of diverse energy sources, either singly or in coordination, for meeting concerns of energy cost, energy security and environmental protection. The book demonstrates how such microgrids, interconnecting groups of generating units and loads within a local area, can be an effective means of balancing electrical supply and demand. It takes advantage of the ability to connect and disconnect microgrids from the main body of the power grid to give flexibility in response to special events, planned or unplanned. In order to capture the main opportunities for expanding the power grid and to present the plethora of associated open problems in control theory Control and Optimization of Distributed Generation Systems is organized to treat three key themes, namely: system architecture and integration; modelling and analysis; and communications and control. Each chapter makes use of examples and simulations and appropriate problems to help the reader study. Tools helpful to the reader in accessing the mathematical analysis presented within the main body of the book are given in an appendix. Control and Optimization of Distributed Generation Systems will enable readers new to the field of distributed power generation and networked control, whether experienced academic migrating from another field or graduate student beginning a research career, to familiarize themselves with the important points of the control and regulation of microgrids. It will also be useful for practising power engineers wishing to keep abreast of changes in power grids necessitated by the diversification of generating methods.

Performance Control of Distributed Generation Using Digital Estimation of Signal Parameters Academic Press

Abstract: A control algorithm was developed that restores the node voltage within 0.85~1.1 per units (p.u.) of a single-phase system during a fault (voltage sag). The control algorithm is based on a 3-phase system voltage support control scheme that corrects the Point of Common Coupling (PCC) voltages during voltage sags. Using these 3-phase mathematical models and equations, previous work was translated from 3-phase to single-phase for this research.

Intelligent Distribution Voltage Control with Distributed Generation Springer

The first extensive reference on these important techniques The restructuring of the electric utility industry has created the need for a mechanism that can effectively coordinate the various entities in a power market, enabling them to communicate efficiently and perform at an optimal level. Communication and Control in Electric Power Systems, the first resource to address its subject in an extended format, introduces parallel and distributed processing techniques as a compelling solution to this critical problem. Drawing on their years of experience in the industry, Mohammad Shahidehpour and Yaoyu Wang deliver comprehensive coverage of parallel and distributed processing techniques with a focus on power system optimization, control, and communication. The authors begin with theoretical background and an overview of the increasingly deregulated power market, then move quickly into the practical applications and implementations of these pivotal techniques. Chapters include: Integrated Control Center Information Parallel and Distributed Computation of Power Systems Common Information Model and Middleware for

Integration Online Distributed Security Assessment and Control Integration, Control, and Operation of Distributed Generation Agent Theory and Power Systems Management e-Commerce of Electricity A ready resource for both students and practitioners, Communication and Control in Electric Power Systems proves an ideal textbook for first-year graduate students in power engineering with an interest in computer communication systems and control center design. Designers, operators, planners, and researchers will likewise appreciate its unique contribution to the professional literature.

Control and Optimization of Distributed Generation Systems John Wiley & Sons Distributed Generation Systems: Design, Operation and Grid Integration closes the information gap between recent research on distributed generation and industrial plants, and provides solutions to their practical problems and limitations. It provides a clear picture of operation principles of distributed generation units, not only focusing on the power system perspective but targeting a specific need of the research community. This book is a useful reference for practitioners, featuring worked examples and figures on principal types of distributed generation with an emphasis on real-world examples, simulations, and illustrations. The book uses practical exercises relating to the concepts of operating and integrating DG units to distribution networks, and helps engineers accurately design systems and reduce maintenance costs. Provides examples and datasheets of principal systems and commercial data in MATLAB Presents guidance for accurate system designs and maintenance costs Identifies trouble shooting references for engineers Closes the information gap between recent research on distributed generation and industrial plants

Voltage Support Control for Single-phase Distributed Generation Inverters Under Faults Nova Science Publishers Nowadays, the electrical energy sector is currently found in a dramatic changing paradigm, which moves towards an increasing trend in generating power at distribution levels, where electricity is typically consumed, by means of non-conventional/renewable based generation units. These new generation technologies, termed as distributed generation, not only offers a non-pollutant, cheap and efficient source of energy to cover increasing demand, but also enhance the reliability of supply to critical loads and reduce the need for additional grid reinforcements. Aside of the technical benefits provided, distributed generation will massively integrate renewable energy resources, with new type of loads and end-user actors, such as prosumers, demand responsive loads, or electric vehicles. Where these actors will actively participate in energy and auxiliary service markets, depending on their available or constrained energy needs. For this reason, the work presented in this Thesis deals with designing and implementing advanced hierarchical control solutions to renewable-based power plants with the purpose of achieving advanced grid conection performance while reaching maximum economic benefits from its optimum real-time operation. Initially, an extensive analysis on the main renewable-based power plant hierarchical control solutions currently on the shelf, is performed. This study not only covered the specific case of renewable-based power plants, but also advanced microgrid and smart grid control solutions. Once the main renewable-based power plant hierarchical solutions were analized, a novel Hierarchical Distributed Control Structure (HDCS) is proposed for increased management of renewable-based active distributed plants. This hierarchical control structure comprises all possible functional levels from the higher long-term economic scheduling layer, to the instantaneous supervisory control of the resource, emphasizing the entire operation and control functionalities needed for increasing the integration of active distributed power plants. In order to achieve real-time control capabilities in active distribution systems, the present thesis introduces a novel power sharing control strategy, based on the competitive operation of multiple active participating agents (distributed generators, demand response and energy storage systems) through the implementation of market rules. Such control capabilities are satisfied by applying a price control signal over the entire grid control architecture, being the final-end participating agent, the responsible entity in charge of deciding its own generation/demand involvement based on its marginal or affordable electricity costs. In addition, it reduces the information volume to be transmitted and processing requirements, as the higher control levels do not need to have knowledge on the detailed distribution system topology and contributing actors. In order to have a meaningful evaluation of the proposed competitive control capabilities, a wave power plant application has been selected, which constitutes a challenging scenario for the controller itself to achieve advanced real-time control capabilities in such an oscillating renewable energy resource. In order to suitably characterize the wave energy resource profile resulting from maximum energy absorption, this Thesis introduce a novel adaptive vector controller, which maximizes the energy extraction from the resource regardless of the dominant irregular wave frequency characteristics. For the specific wave power plant application considered, the competitive control does not only ensures real-time optimum resource allocation for satisfying a given production objective, but also provides optimum long term operation of the system. As a result, overall plant costs reductions can be achieved under the competitive operation, since the plant scheduled energy is satisfied by making use of the generation units with cheaper cumulative operation costs.

Distributed Generation A practical and systematic elaboration on the analysis, design and control of grid integrated and standalone distributed photovoltaic (PV) generation systems, with Matlab and Simulink models Analyses control of distribution networks with high penetration of PV systems and standalone microgrids with PV systems Covers in detail PV accommodation techniques including energy storage, demand side management and PV output power regulation Features examples of real projects/systems given in OPENDSS codes and/or Matlab and Simulink models Provides a concise summary of up-to-date research around the word in distributed PV systems

Efficient Integration of Distributed Generation in Electricity Distribution Networks The book contains 10 chapters, and it is divided into four sections. The first section includes three chapters, providing an overview of Energy Management of Distributed Systems. It outlines typical concepts, such as Demand-Side Management, Demand Response, Distributed, and Hierarchical Control for Smart Micro-Grids. The second section contains three chapters and presents different control algorithms, software architectures, and simulation tools dedicated to Energy Management Systems. In the third section, the importance and the role of energy storage technology in a Distribution System, describing and comparing different types of energy storage systems, is shown. The fourth section shows how to identify and address potential threats for a Home Energy Management System. Finally, the fifth section discusses about Economical

Optimization of Operational Cost for Micro-Grids, pointing out the effect of renewable energy sources, active loads, and energy storage systems on economic operation.

Control and Protection Analysis for Power Distribution in a Distributed Generation System

The only book available on fuel cell modeling and control with distributed power generation applications The emerging fuel cell (FC) technology is growing rapidly in its applications from small-scale portable electronics to large-scale power generation. This book gives students, engineers, and scientists a solid understanding of the FC dynamic modeling and controller design to adapt FCs to particular applications in distributed power generation. The book begins with a fascinating introduction to the subject, including a brief history of the U.S. electric utility formation and restructuring. Next, it provides coverage of power deregulation and distributed generation (DG), DG types, fuel cell DGs, and the hydrogen economy. Building on that foundation, it covers: Principle operations of fuel cells Dynamic modeling and simulation of PEM and solid-oxide fuel cells Principle operations and modeling of electrolyzers Power electronic interfacing circuits for fuel cell applications Control of grid-connected and stand-alone fuel cell power generation systems Hybrid fuel cell–based energy system case studies Present challenges and the future of fuel cells MATLAB/SIMULINK-based models and their applications are available via a companion Web site. Modeling and Control of Fuel Cells is an excellent reference book for students and professionals in electrical, chemical, and mechanical engineering and scientists working in the FC area.

Handbook of Distributed Generation