

Modern Electrical Drives: Trends, Problems, and Challenges

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1. Introduction

Modern electrical drives possess many advantages. Electrical energy, compared to other sources, is easy to transport and can be environmentally friendly (if it comes from renewable sources). Electrical drives convert energy with high efficiency and have flexible control characteristics. They offer a wide range of speed, torque, and power operations. Furthermore, in general, they can serve as electrical generators.

With the growing demand for high-performance electrical drives, many universities and industrial researchers have focused on the problems surrounding the efficient, robust, precise, and fault-tolerant controls of these drives. In various industries, accurate control of electrical drives is crucial, from high-power drives evident in mining and petrochemical areas, to medium (automotive industries, robot arm drives, CNC machines) and small power drives (actuators), MEMS, etc.

In this Special Issue, the topics related to trends, problems, and challenges linked to the design and exploitation of modern electrical drives are presented. The submitted manuscripts, and those finally selected for publication in this Special Issue, focus on the trends, problems, and challenges in modern electrical drives. Very often, they are multidisciplinary works. In this Special Issue, 10 manuscripts were published that deal with the following topics: control strategies for different types of electrical motors [1–3], estimations of non-measurable states and parameters [3], sensorless control of electrical drives [1,2], the application of advanced control methodologies for high performance control of electrical drives [4–6], diagnoses, monitoring, and prognoses in electrical drives [7–10], and control of complex mechatronic systems, while taking the mechanical part of the system into account [3,4,6].

This publication is divided into two important sections: a short review of the contributions, where important contributions to the development of electric drives are presented, and a summary of the work.

2. A Short Review of the Contributions in This Issue

The main idea of the article [1] is to create a buffer power supply system for an asynchronous electrical drive, and to develop a strategy for a control system for this buffer power by using a bidirectional DC–DC converter. The article describes the process of creating a model of an electric drive, buffer source, control system, and frequency regulation based on MATLAB–Simulink. Simulations of the operations of this system were carried out together with a buffer source based on the supercapacitors. The adequacy and accuracy of the calculated mathematical expressions were proven. An algorithm for the operation of the control system for the buffer power source was proposed.

In [2], Bednarski et al. proposed and experimentally examined a family of generalized microstepping signal shapes for stepper motors. The authors provided the mathematical



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Modern Electrical Drives

Jens Weidauer, Richard Messer



Modern Electrical Drives:

Modern Electrical Drives H. Bülent Ertan, M. Yildirim Üçtug, Ron Colyer, Alfio Consoli, 2013-06-29 Electrical drives lie at the heart of most industrial processes and make a major contribution to the comfort and high quality products we all take for granted They provide the controller power needed at all levels from megawatts in cement production to milliwatts in wrist watches Other examples are legion from the domestic kitchen to public utilities The modern electrical drive is a complex item comprising a controller a static converter and an electrical motor Some can be programmed by the user Some can communicate with other drives Semiconductor switches have improved intelligent power modules have been introduced all of which means that control techniques can be used now that were unimaginable a decade ago Nor has the motor side stood still high energy permanent magnets semiconductor switched reluctance motors silicon micromotor technology and soft magnetic materials produced by powder technology are all revolutionising the industry But the electric drive is an enabling technology so the revolution is rippling throughout the whole of industry *Electrical Drives* Jens Weidauer, Richard Messer, 2014-07-07 From the point of view of a user this book covers all aspects of modern electrical drives It is aimed at both users who wish to understand design use and maintain electrical drives as well as specialists technicians engineers and students who wish to gain a comprehensive overview of electrical drives Jens Weidauer and Richard Messer describe the principles of electrical drives their design and application through to complex automation solutions In the process they introduce the entire spectrum of drive solutions available and their main applications A special aspect is the combination of multiple drives to form a drive system as well as the integration of drives into automation solutions In simple and clear language and supported with many diagrams complex relationships are described and presented in an easy to understand way The authors deliberately avoid a comprehensive mathematical treatment of their subject and instead focus on a coherent description of the active principles and relationships As a result the reader will be in a position to understand electrical drives as a whole and to solve drive related problems in everyday professional life Sliding Mode Control for Synchronous Electric Drives Sergey E. Ryvkin, Eduardo Palomar Lever, 2011-11-21 This volume presents the theory of control systems with sliding mode applied to electrical motors and power converters It demonstrates the methodology of control design and the original algorithms of control and observation Practically all semiconductor devices are used in power converters that feed electrical motors as power switches A switch Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, 2018-02-02 This book is an introduction to automotive technology with specific reference to battery electric hybrid electric and fuel cell electric vehicles It could serve electrical engineers who need to know more about automobiles or automotive engineers who need to know about electrical propulsion systems For example this reviewer who is a specialist in electric machinery could use this book to better understand the automobiles for which the reviewer is designing electric drive motors An automotive engineer on the other hand might use it to better understand the

nature of motors and electric storage systems for application in automobiles trucks or motorcycles The early chapters of the book are accessible to technically literate people who need to know something about cars While the first chapter is historical in nature the second chapter is a good introduction to automobiles including dynamics of propulsion and braking The third chapter discusses in some detail spark ignition and compression ignition Diesel engines The fourth chapter discusses the nature of transmission systems James Kirtley Massachusetts Institute of Technology USA The third edition covers extensive topics in modern electric hybrid electric and fuel cell vehicles in which the profound knowledge mathematical modeling simulations and control are clearly presented Featured with design of various vehicle drivetrains as well as a multi objective optimization software it is an estimable work to meet the needs of automotive industry Haiyan Henry Zhang Purdue University USA The extensive combined experience of the authors have produced an extensive volume covering a broad range but detailed topics on the principles design and architectures of Modern Electric Hybrid Electric and Fuel Cell Vehicles in a well structured clear and concise manner The volume offers a complete overview of technologies their selection integration control as well as an interesting Technical Overview of the Toyota Prius The technical chapters are complemented with example problems and user guides to assist the reader in practical calculations through the use of common scientific computing packages It will be of interest mainly to research postgraduates working in this field as well as established academic researchers industrial R D engineers and allied professionals Christopher Donaghy Sparg Durham University United Kingdom The book deals with the fundamentals theoretical bases and design methodologies of conventional internal combustion engine ICE vehicles electric vehicles EVs hybrid electric vehicles HEVs and fuel cell vehicles FCVs The design methodology is described in mathematical terms step by step and the topics are approached from the overall drive train system not just individual components Furthermore in explaining the design methodology of each drive train design examples are presented with simulation results All the chapters have been updated and two new chapters on Mild Hybrids and Optimal Sizing and Dimensioning and Control are also included Chapters updated throughout the text New homework problems solutions and examples Includes two new chapters Features accompanying MATLABTM software

Electric Drives and Electromechanical Systems Richard Crowder, 2019-10-19 *Electric Drives and Electromechanical Devices Applications and Control* Second Edition presents a unified approach to the design and application of modern drive system It explores problems involved in assembling complete modern electric drive systems involving mechanical electrical and electronic elements This book provides a global overview of design specification applications important design information and methodologies This new edition has been restructured to present a seamless logical discussion on a wide range of topical problems relating to the design and specification of the complete motor drive system It is organised to establish immediate solutions to specific application problem Subsidiary issues that have a considerable impact on the overall performance and reliability including environmental protection and costs energy efficiency and cyber security are also

considered Presents a comprehensive consideration of electromechanical systems with insights into the complete drive system including required sensors and mechanical components Features in depth discussion of control schemes particularly focusing on practical operation Includes extensive references to modern application domains and real world case studies such as electric vehicles Considers the cyber aspects of drives including networking and security **Monographs in**

Modern Electrical Technology Alexander Kusko,1969

Advanced Electrical Drives Rik W. De Doncker,Duco W.J.

Pulle,André Veltman,2020-08-21 This book provides a unique approach to derive model based torque controllers for all types of Lorentz force machines i e DC synchronous and induction machines The rotating transformer model forms the basis for the generalized modeling approach of rotating field machines which leads to the development of universal field oriented control algorithms Contrary to this direct torque control algorithms using observer based methods are developed for switched reluctance machines Tutorials are included at the end of each chapter and the reader is encouraged to execute these tutorials in order to gain familiarity with the dynamic behavior of drive systems This updated edition uses PLECS simulation and vector processing tools that were specifically adopted for the purpose of these hands on tutorials Hence Advanced Electrical Drives encourages learning by doing and the experienced drive specialist may find the simulation tools useful to design high performance torque controllers Although it is a powerful reference in its own right when used in conjunction with the companion texts Fundamentals of Electrical Drives and Applied Control of Electrical Drives this book provides a uniquely comprehensive reference set that takes readers all the way from understanding the basics of how electrical drives work to deep familiarity with advanced features and models to a mastery of applying the concepts to actual hardware in practice Teaches readers to perform insightful analysis of AC electrical machines and drives Introduces new modeling methods and modern control techniques for switched reluctance drives Updated to use PLECS simulation tools for modeling electrical drives including new and more experimental results Numerous tutorials at end of each chapter to learn by doing step by step Includes extra material featuring build and play lab modules for lectures and self study **Electrical Drive**

Simulation with MATLAB/Simulink Viktor Perelmuter,2024-04-26

The chapters of this book discuss the modeling of electric drives taking into account their relationship with the technological process they serve which significantly affects the composition layout and characteristics of the electric drive There are no published books of this kind and this book fills a gap in the literature This book deals with electric drives for rolling mills paper machines a number of several hoisting and transport devices these installations are very common and very complex so that modeling methods in their development and study are mandatory The book focuses on issues such as the transmission of torque by elastic shafts the transmission of torque by an endless elastic belt in paper machines and conveyors the transmission of torque by friction of pressed rolls in the paper industry the consideration of the elastic properties of long ropes in some hoisting and transport machines and the effect of swinging a moving load in such machines More than 100 models of the electrical drives that are made with the use

of the program environment MATLAB Simulink are appended to this book. The aims of these models are to aid students studying electrical drives of the various manufacturing machines to facilitate the understanding of various electrical drive functions and to create a platform for the development of systems by readers in their fields. This book can be used by engineers and investigators as well as undergraduate and graduate students to develop new electrical drives and investigate the existing ones.

Advanced Control of Electrical Drives and Power Electronic Converters Jacek Kabziński, 2016-09-30. This contributed volume is written by key specialists working in multidisciplinary fields in electrical engineering linking control theory, power electronics, artificial neural networks, embedded controllers, and signal processing. The authors of each chapter report the state of the art of the various topics addressed and present results of their own research, laboratory experiments, and successful applications. The presented solutions concentrate on three main areas of interest: motion control in complex electromechanical systems including sensorless control, fault diagnosis, and fault tolerant control of electric drives; new control algorithms for power electronics converters. The chapters and the complete book possess strong monograph attributes. Important practical and theoretical problems are deeply and accurately presented on the background of an exhaustive state of the art review. Many results are completely new and were never published before. Well-known control methods like field-oriented control (FOC) or direct torque control (DTC) are referred to as a starting point for modifications or are used for comparison. Among numerous control theories used to solve particular problems are nonlinear control, robust control, adaptive control, Lyapunov techniques, observer design, model predictive control, neural control, sliding mode control, signal filtration, and processing, fault diagnosis, and fault tolerant control.

Dynamics and Control of Electrical Drives Wach Piotr, 2011-04-28. Dynamics is a science concerned with movement and changes. In the most general approach, it relates to life processes as well as behavior in nature, in rest. It governs small particles, technical objects, conversion of matter and materials, but also concerns people, groups of people in their individual and in particular social dimension. In dynamics, we always have to do with causes or stimuli for motion, the rules of reaction or behavior, and its result in the form of trajectory of changes. This book is devoted to dynamics of a wide class of specific but very important objects such as electromechanical systems. This is a very rigorous discipline and has a long tradition as its theoretical bases were formulated in the first half of the XIX century by d'Alembert, Lagrange, Hamilton, Maxwell, and other prominent scientists, but their crucial results were based on previous pioneering research of others such as Copernicus, Galileo, Newton. This book, in its theoretical foundations, is based on the principle of least action, which governs classical as well as relativistic mechanics and electromagnetism and leads to Lagrange's equations, which are applied in the book as a universal method to construct equations of motion of electromechanical systems. It gives common and coherent grounds to formulate mathematical models for all lumped parameters electromechanical systems, which are vital in our contemporary industry and civilized everyday life. From these remarks, it seems that the book is general and theoretical, but in fact, it is a very practical one concerning modern electrical

drives in a broad sense including electromechanical energy conversion induction motor drives brushless DC drives with a permanent magnet excitation and switched reluctance machines SRM And of course their control which means shaping of their trajectories of motion using modern tools their designed autonomy in keeping a track according to our programmed expectations The problems presented in the book are widely illustrated by characteristics trajectories dynamic courses all computed by use of developed simulation models throughout the book There are some classical subjects and the history of the discipline is discussed but finally all modern tools and means are presented and applied More detailed descriptions follow in abstracts for the particular chapters The author hopes kind readers will enjoy and profit from reading this book

Fundamentals of Electrical Drives DUBEY GOPAL K,2002-06-13 Encouraged by the response to the first edition and to keep pace with recent developments Fundamentals of Electrical Drives Second Edition incorporates greater details on semi conductor controlled drives includes coverage of permanent magnet AC motor drives and switched reluctance motor drives and highlights new trends in drive technology Contents were chosen to satisfy the changing needs of the industry and provide the appropriate coverage of modern and conventional drives With the large number of examples problems and solutions provided Fundamentals of Electrical Drives Second Edition will continue to be a useful reference for practicing engineers and for those preparing for Engineering Service Examinations Electric Drives Ion Boldea,Syed A.

Nasar,2016-09-15 Electric Drives provides a practical understanding of the subtleties involved in the operation of modern electric drives The Third Edition of this bestselling textbook has been fully updated and greatly expanded to incorporate the latest technologies used to save energy and increase productivity stability and reliability Every phrase equation number and reference in the text has been revisited with the necessary changes made throughout In addition new references to key research and development activities have been included to accurately reflect the current state of the art Nearly 120 new pages covering recent advances such as those made in the sensorless control of A C motor drives have been added as have two new chapters on advanced scalar control and multiphase electric machine drives All solved numerical examples have been retained and the 10 MATLAB Simulink programs remain online Thus Electric Drives Third Edition offers an up to date synthesis of the basic and advanced control of electric drives with ample material for a two semester course at the university level

Electric Drives, Second Edition Ion Boldea,Syed A. Nasar,2005-08-22 Electric drives are everywhere and with the looming promise of electric vehicles and renewable energy they will become more complex and the demands on their capabilities will continue to increase To keep up with these trends students require hands on knowledge and a keen understanding of the subtleties involved in the operation of modern electric drives The best selling first edition of Electric Drives provided such an understanding and this Second Edition offers the same approach with up to date coverage of all major types of electric drives both constant and variable speed This book provides a self contained treatment of low medium and large power drives illustrated by numerous application examples problems digital simulation results and test results for

both steady state and dynamic operation This edition features updated material in every chapter including references new material on AC brush series motors capacitor split inductor motors single phase PMSMs and switched reluctance motors and tooth wound PMSMs all with numerical examples new case studies on AC synchronous and induction motors and a new chapter on control of electric generators The companion CD ROM features the full text class slides for instructors and MATLAB simulations of 10 closed loop drives two of which are new to this edition With a practical hands on approach Electric Drives Second Edition is the ideal textbook to help students design simulate build and test modern electric drives from simple to complex **Advanced Electrical Drives** Rik De Doncker, Duco W.J. Pulle, André Veltman, 2010-11-30

Electrical drives convert in a controlled manner electrical energy into mechanical energy Electrical drives comprise an electrical machine i e an electro mechanical energy converter a power electronic converter i e an electrical to electrical converter and a controller communication unit Today electrical drives are used as propulsion systems in high speed trains elevators escalators electric ships electric forklift trucks and electric vehicles Advanced control algorithms mostly digitally implemented allow torque control over a high bandwidth Hence precise motion control can be achieved Examples are drives in robots pick and place machines factory automation hardware etc Most drives can operate in motoring and generating mode Wind turbines use electrical drives to convert wind energy into electrical energy More and more variable speed drives are used to save energy for example in air conditioning units compressors blowers pumps and home appliances Key to ensure stable operation of a drive in the aforementioned applications are torque control algorithms In Advanced Electrical Drives a unique approach is followed to derive model based torque controllers for all types of Lorentz force machines i e DC synchronous and induction machines The rotating transformer model forms the basis for this generalized modeling approach that ultimately leads to the development of universal field oriented control algorithms In case of switched reluctance machines torque observers are proposed to implement direct torque algorithms From a didactic viewpoint tutorials are included at the end of each chapter The reader is encouraged to execute these tutorials to familiarize him or herself with all aspects of drive technology Hence Advanced Electrical Drives encourages learning by doing Furthermore the experienced drive specialist may find the simulation tools useful to design high performance controllers for all sorts of electrical drives

Electrical Machine Drives Control Juha Pyrhonen, Valeria Hrabovcova, R. Scott Semken, 2016-10-10 This comprehensive text examines existing and emerging electrical drive technologies The authors clearly define the most basic electrical drive concepts and go on to explain the most important details while maintaining a solid connection to the theory and design of the associated electrical machines Also including links to a number of industrial applications the authors take their investigation of electrical drives beyond theory to examine a number of practical aspects of electrical drive control and application Key features Provides a comprehensive summary of all aspects of controlled speed electrical drive technology including control and operation Handling of electrical drives is solidly linked to the theory and design of the associated electrical machines

Added insight into problems and functions are illustrated with clearly understandable figures Offers an understanding of the main phenomena associated with electrical machine drives Considers the problem of bearing currents and voltage stresses of an electrical drive Includes up to date theory and design guidelines taking into account the most recent advances This book s rigorous coverage of theoretical principles and techniques makes for an excellent introduction to controlled speed electrical drive technologies for Electrical Engineering MSc or PhD students studying electrical drives It also serves as an excellent reference for practicing electrical engineers looking to carry out design analyses and development of controlled speed electrical drives

Drives and Control for Industrial Automation Kok Kiong Tan, Andi Sudjana Putra, 2010-11-16 Drives and Control for Industrial Automation presents the material necessary for an understanding of servo control in automation Beginning with a macroscopic view of its subject treating drives and control as parts of a single system the book then pursues a detailed discussion of the major components of servo control sensors controllers and actuators Throughout the mechatronic approach a synergistic integration of the components is maintained in keeping with current practice The authors holistic approach does not preclude the reader from learning in a step by step fashion each chapter contains material that can be studied separately without compromising understanding Drives are described in several chapters according to the way they are usually classified in industry each comprised of its actuators and sensors The controller is discussed alongside Topics of recent and current interest piezoelectricity digital communications and future trends are detailed in their own chapters

Electrical Drives and Control Mr. Rohit Manglik, 2024-07-28 EduGorilla Publication is a trusted name in the education sector committed to empowering learners with high quality study materials and resources Specializing in competitive exams and academic support EduGorilla provides comprehensive and well structured content tailored to meet the needs of students across various streams and levels

Modern Electric Vehicle Technology C. C. Chan, K. T. Chau, 2001 A comprehensive and up to date reference book on modern electric vehicle technology which covers the engineering philosophy state of the art technology and commercialisation of electrical vehicles

Electrical Machine and Drive (Introduce to Advance Control) Rajendra Aparnathi, Ved Vyas Dwivedi, 2013-09-27 This Book is a source for B E M E and research aspirants Working in the fields of inverters converters and Advance technique in Electrical and Electronics Engineering

[Handbook of Modern Electric Railway Methods and Practices](#) American Transit Association, 1925

Adopting the Track of Expression: An Emotional Symphony within **Modern Electrical Drives**

In some sort of taken by monitors and the ceaseless chatter of quick transmission, the melodic beauty and emotional symphony developed by the written term often disappear into the backdrop, eclipsed by the constant sound and disruptions that permeate our lives. But, located within the pages of **Modern Electrical Drives** an enchanting fictional value full of natural thoughts, lies an immersive symphony waiting to be embraced. Constructed by an outstanding musician of language, this fascinating masterpiece conducts readers on an emotional journey, well unraveling the hidden melodies and profound impact resonating within each cautiously constructed phrase. Within the depths of this emotional assessment, we will explore the book is central harmonies, analyze its enthralling writing model, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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