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Digital Control in Power Electronics

Second Edition

Simone Buso
Paolo Mattavelli

**SYNTHESIS LECTURES ON
POWER ELECTRONICS**

Jerry Hudgins, Series Editor

Digital Control In Power Electronics Synthesis Lectures

On Power Electronics

Farzin Asadi

Digital Control In Power Electronics Synthesis Lectures On Power Electronics:

Digital Control in Power Electronics Simone Buso,Paolo Mattavelli,2006 Digital Control in Power Electronics presents students of electrical engineering a basic introduction to typical power converter control problems their digital solutions and the most widespread digital control techniques Although the presentation has been limited to a single converter topology the half bridge voltage source inverter the control topics represent a significant spectrum of the more frequently encountered digital control applications in power electronics Authors Paolo Mattavelli and Simone Buso introduce the reader to basic control problems in power electronic circuits in order to illustrate widely applied digital solutions to these problems They also aim to raise students awareness of discrete time control theory stimulating new developments in its application to power converters

Digital Control in Power Electronics Simone Buso,Paolo Mattavelli,2015-05-01 This book presents the reader whether an electrical engineering student in power electronics or a design engineer a selection of power converter control problems and their basic digital solutions based on the most widespread digital control techniques The presentation is primarily focused on different applications of the same power converter topology the half bridge voltage source inverter considered both in its single and three phase implementation This is chosen as the test case because besides being simple and well known it allows the discussion of a significant spectrum of the most frequently encountered digital control applications in power electronics from digital pulse width modulation DPWM and space vector modulation SVM to inverter output current and voltage control ending with the relatively more complex VSI applications related to the so called smart grid scenario This book aims to serve two purposes 1 to give a basic introductory knowledge of the digital control techniques applied to power converters and 2 to raise the interest for discrete time control theory stimulating new developments in its application to switching power converters

Digital Control In Power Electronics S. Morgan Buso,2006 *Digital Control in Power Electronics, 2nd Edition* Simone Buso,Paolo Mattavelli,2015-05-08 This book presents the reader whether an electrical engineering student in power electronics or a design engineer a selection of power converter control problems and their basic digital solutions based on the most widespread digital control techniques The presentation is primarily focused on different applications of the same power converter topology the half bridge voltage source inverter considered both in its single and three phase implementation This is chosen as the test case because besides being simple and well known it allows the discussion of a significant spectrum of the most frequently encountered digital control applications in power electronics from digital pulse width modulation DPWM and space vector modulation SVM to inverter output current and voltage control ending with the relatively more complex VSI applications related to the so called smart grid scenario This book aims to serve two purposes 1 to give a basic introductory knowledge of the digital control techniques applied to power converters and 2 to raise the interest for discrete time control theory stimulating new developments in its application to switching power converters *Digital Control in Power Electronics, 2nd Edition* Simone Buso,Paolo Mattavelli,2022-05-31

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

Dynamics and Control of DC-DC Converters Farzin Asadi, Kei Eguchi, 2022-05-31 DC DC converters have many applications in the modern world. They provide the required power to the communication backbones they are used in digital devices like laptops and cell phones and they have widespread applications in electric cars to just name a few. DC DC converters require negative feedback to provide a suitable output voltage or current for the load. Obtaining a stable output voltage or current in presence of disturbances such as input voltage changes and or output load changes seems impossible without some form of control. This book tries to train the art of controller design for DC DC converters. Chapter 1 introduces the DC DC converters briefly. It is assumed that the reader has the basic knowledge of DC DC converter i e a basic course in power electronics. The reader learns the disadvantages of open loop control in Chapter 2. Simulation of DC DC converters with the aid of Simulink is discussed in this chapter as well. Extracting the dynamic models of DC DC converters is studied in Chapter 3. We show how MATLAB and a software named KUCA can be used to do the cumbersome and error prone process of modeling automatically. Obtaining the transfer functions using PSIM is studied as well. These days softwares are an integral part of engineering sciences. Control engineering is not an exception by any means. Keeping this in mind we design the controllers using MATLAB in Chapter 4. Finally references are provided at the end of each chapter to suggest more information for an interested reader. The intended audiences for this book are practice engineers and academians

Computer Techniques for Dynamic Modeling of DC-DC Power Converters Farzin Asadi, 2022-06-01 Computers play an important role in the analyzing and designing of modern DC DC power converters. This book shows how the widely used analysis techniques of averaging and linearization can be applied to DC DC converters with the aid of computers. Obtained dynamical equations may then be used for control design. The book is composed of two chapters. Chapter 1 focuses on the extraction of control to output transfer function. A second order converter a buck converter and a fourth order converter a Zeta converter are studied as illustrative examples in this chapter. Both ready to use software packages such as PLECS and MATLAB programming are used throughout this chapter.

The input output characteristics of DC DC converters are the object of considerations in Chapter 2 Calculation of input output impedance is done with the aid of MATLAB programming in this chapter The buck buck boost and boost converter are the most popular types of DC DC converters and used as illustrative examples in this chapter This book can be a good reference for researchers involved in DC DC converters dynamics and control

Robust Control of DC-DC Converters

Farzin Asadi,2022-05-31 DC DC converters require negative feedback to provide a suitable output voltage or current for the load Obtaining a stable output voltage or current in the presence of disturbances like input voltage changes and or output load changes seems impossible without some form of control This book shows how simple controllers such as Proportional Integral PI can turn into a robust controller by correct selection of its parameters Kharitonov s theorem is an important tool toward this end This book consist of two parts The first part shows how one can obtain the interval plant model of a DC DC converter The second part introduces the Kharitonov s theorem Kharitonov s theorem is an analysis tool rather than a design tool Some case studies show how it can be used as a design tool The prerequisite for reading this book is a first course on feedback control theory and power electronics

Transient Electro-Thermal Modeling on Power Semiconductor

Devices Tanya Kirilova Gachovska,Jerry Hudgins,Bin Du,Enrico Santi,2022-06-01 This book presents physics based electro thermal models of bipolar power semiconductor devices including their packages and describes their implementation in MATLAB and Simulink It is a continuation of our first book Modeling of Bipolar Power Semiconductor Devices The device electrical models are developed by subdividing the devices into different regions and the operations in each region along with the interactions at the interfaces are analyzed using the basic semiconductor physics equations that govern device behavior The Fourier series solution is used to solve the ambipolar diffusion equation in the lightly doped drift region of the devices In addition to the external electrical characteristics internal physical and electrical information such as junction voltages and carrier distribution in different regions of the device can be obtained using the models The instantaneous dissipated power calculated using the electrical device models serves as input to the thermal model RC network with constant and nonconstant thermal resistance and thermal heat capacity or Fourier thermal model of the entire module or package which computes the junction temperature of the device Once an updated junction temperature is calculated the temperature dependent semiconductor material parameters are re calculated and used with the device electrical model in the next time step of the simulation The physics based electro thermal models can be used for optimizing device and package design and also for validating extracted parameters of the devices The thermal model can be used alone for monitoring the junction temperature of a power semiconductor device and the resulting simulation results used as an indicator of the health and reliability of the semiconductor power device

Digital Control of High-Frequency Switched-Mode Power

Converters Luca Corradini,Dragan Maksimovic,Paolo Mattavelli,Regan Zane,2015-06-09 This book is focused on the fundamental aspects of analysis modeling and design of digital control loops around high frequency switched mode power

converters in a systematic and rigorous manner Comprehensive treatment of digital control theory for power converters Verilog and VHDL sample codes are provided Enables readers to successfully analyze model design and implement voltage current or multi loop digital feedback loops around switched mode power converters Practical examples are used throughout the book to illustrate applications of the techniques developed Matlab examples are also provided Graduate Studies

,1992 *Digital Power Electronics and Applications* Fang Lin Luo,Hong Ye,Muhammad H. Rashid,2010-07-20 The purpose of this book is to describe the theory of Digital Power Electronics and its applications The authors apply digital control theory to power electronics in a manner thoroughly different from the traditional analog control scheme In order to apply digital control theory to power electronics the authors define a number of new parameters including the energy factor pumping energy stored energy time constant and damping time constant These parameters differ from traditional parameters such as the power factor power transfer efficiency ripple factor and total harmonic distortion These new parameters result in the definition of new mathematical modeling A zero order hold ZOH is used to simulate all AC DC rectifiers A first order hold FOH is used to simulate all DC AC inverters A second order hold SOH is used to simulate all DC DC converters A first order hold FOH is used to simulate all AC AC AC DC AC converters Presents most up to date methods of analysis and control algorithms for developing power electronic converters and power switching circuits Provides an invaluable reference for engineers designing power converters commercial power supplies control systems for motor drives active filters etc Presents methods of analysis not available in other books Dynamics and Control of DC-DC Converters Farzin Asadi,Kei

Eguchi,2018-03-08 DC DC converters have many applications in the modern world They provide the required power to the communication backbones they are used in digital devices like laptops and cell phones and they have widespread applications in electric cars to just name a few DC DC converters require negative feedback to provide a suitable output voltage or current for the load Obtaining a stable output voltage or current in presence of disturbances such as input voltage changes and or output load changes seems impossible without some form of control This book tries to train the art of controller design for DC DC converters Chapter 1 introduces the DC DC converters briefly It is assumed that the reader has the basic knowledge of DC DC converter i e a basic course in power electronics The reader learns the disadvantages of open loop control in Chapter 2 Simulation of DC DC converters with the aid of Simulink is discussed in this chapter as well Extracting the dynamic models of DC DC converters is studied in Chapter 3 We show how MATLAB and a software named KUCA can be used to do the cumbersome and error prone process of modeling automatically Obtaining the transfer functions using PSIM is studied as well These days softwares are an integral part of engineering sciences Control engineering is not an exception by any means Keeping this in mind we design the controllers using MATLAB in Chapter 4 Finally references are provided at the end of each chapter to suggest more information for an interested reader The intended audiences for this book are practice engineers and academians **Lecture Notes - Power Electronics** Rik De Doncker,2013 Catalogs of

Courses University of California, Berkeley, 1995 Includes general and summer catalogs issued between 1878 1879 and 1995

1997 **Special Issue on Digital Control in Power Electronics** ,2003 **Which Degree?** ,1981 *High-Robust*

Control Schemes for Dual-Active-Bridge-Based DC-DC Converter Systems in Renewable Energy Applications Nie

Hou,2024-10-31 High Robust Control Schemes for Dual Active Bridge Based DC DC Converter Systems in Renewable Energy Applications is the first book that presents systematic control schemes for multiple DAB based DC DC converter systems The book explores new control methods for various DAB DC DC converters for high power applications These methods include fast dynamic control power balance control soft start up operation hot swap operation and circuit parameter estimation Additionally the book studies a DAB based partial power processing DC DC converter system designed to embed the renewable energy source and the energy storage system for boosting the utilization of components The book also verifies the dynamic equivalence between the DAB converter and other intermediary inductive AC link DC DC converters which can be helpful in designing control systems for other AC link based DC DC converter systems This book is a valuable reference for graduate students in electrical engineering researchers and power electronics engineers working in manufacturing renewable energy and utility industries *Integrated Power Electronic Converters and Digital Control* Ali Emadi,Alireza Khaligh,Zhong Nie,Young Joo Lee,2017-12-19

Because of the demand for higher efficiencies smaller output ripple and smaller converter size for modern power electronic systems integrated power electronic converters could soon replace conventional switched mode power supplies Synthesized integrated converters and related digital control techniques address problems related to cost space flexibility energy efficiency and voltage regulation the key factors in digital power management and implementation Meeting the needs of professionals working in power electronics as well as advanced engineering students Integrated Power Electronic Converters and Digital Control explores the many benefits associated with integrated converters This informative text details boost type buck type and buck boost type integrated topologies as well as other integrated structures It discusses concepts behind their operation as well specific applications Topics discussed include Isolated DC DC converters such as flyback forward push pull full bridge and half bridge Power factor correction and its application Definition of the integrated switched mode power supplies Steady state analysis of the boost integrated flyback rectifier energy storage converter Dynamic analysis of the buck integrated forward converter Digital control based on the use of digital signal processors DSPs With innovations in digital control becoming ever more pervasive system designers continue to introduce products that integrate digital power management and control integrated circuit solutions both hybrid and pure digital This detailed assessment of the latest advances in the field will help anyone working in power electronics and related industries stay ahead of the curve **Special Issue on Digital Control in Power Electronics** Steven B. Leeb,2003

Digital Control In Power Electronics Synthesis Lectures On Power Electronics Book Review: Unveiling the Magic of Language

In an electronic era where connections and knowledge reign supreme, the enchanting power of language has been much more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is truly remarkable. This extraordinary book, aptly titled "**Digital Control In Power Electronics Synthesis Lectures On Power Electronics**," written by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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Table of Contents Digital Control In Power Electronics Synthesis Lectures On Power Electronics

1. Understanding the eBook Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - The Rise of Digital Reading Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Advantages of eBooks Over Traditional Books
2. Identifying Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an eBook Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - User-Friendly Interface
4. Exploring eBook Recommendations from Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Personalized Recommendations
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics User Reviews and Ratings

- Digital Control In Power Electronics Synthesis Lectures On Power Electronics and Bestseller Lists
- 5. Accessing Digital Control In Power Electronics Synthesis Lectures On Power Electronics Free and Paid eBooks
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics Public Domain eBooks
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics eBook Subscription Services
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics Budget-Friendly Options
- 6. Navigating Digital Control In Power Electronics Synthesis Lectures On Power Electronics eBook Formats
 - ePUB, PDF, MOBI, and More
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics Compatibility with Devices
 - Digital Control In Power Electronics Synthesis Lectures On Power Electronics Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Highlighting and Note-Taking Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Interactive Elements Digital Control In Power Electronics Synthesis Lectures On Power Electronics
- 8. Staying Engaged with Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Digital Control In Power Electronics Synthesis Lectures On Power Electronics
- 9. Balancing eBooks and Physical Books Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Digital Control In Power Electronics Synthesis Lectures On Power Electronics
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Setting Reading Goals Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Digital Control In Power Electronics Synthesis Lectures On Power Electronics
 - Fact-Checking eBook Content of Digital Control In Power Electronics Synthesis Lectures On Power Electronics

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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