



Digital Control System Analysis and Design

FOURTH EDITION

Charles L. Phillips • H. Troy Nagle • Aranya Chakraborty



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Digital Control System Analysis Design 4th Edition

Charles L. Phillips, H. Troy Nagle (Jr.)



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Digital Control System Analysis and Design Charles L. Phillips, H. Troy Nagle (Jr.), 1984 This revision of the best selling book for the digital controls course features new running applications and integration of MATLAB the most widely used software in controls Coverage of root locus design and the Fourier transform have also been increased Digital Control System Analysis and Design Charles L. Phillips, H. Troy Nagle, Aranya Chakraborty, 2014-08-04 Appropriate for a one semester two quarter senior level course in digital or discrete time controls This revision of the best selling text in digital controls is a significant update with the integration of MATLAB software and new coverage in several areas This program presents a better teaching and learning experience for you and your students Provide MATLAB programs to students Short MATLAB programs have been included in many of the examples which allow students to experiment and learn more skills Motivate students with running applications that are featured throughout the book Simple physical systems are introduced in one chapter and then used again later to illuminate more advanced material Reinforce core concepts with examples and problems Over 400 problems and 130 worked examples help students grasp the text's concepts Introduction to Digital Control Biswanath Samanta, 2024-10-17 This textbook presents an integrated approach to digital discrete time control systems covering analysis design simulation and real time implementation through relevant hardware and software platforms Topics related to discrete time control systems include z transform inverse z transform sampling and reconstruction open and closed loop system characteristics steady state accuracy for different system types and input functions stability analysis in z domain Jury's test bilinear transformation from z to w domain stability analysis in w domain Routh Hurwitz criterion root locus techniques in z domain frequency domain analysis in w domain control system specifications in time and frequency domains design of controllers PI PD PID phase lag phase lead phase lag lead using time and frequency domain specifications state space methods controllability and observability pole placement controllers design of observers estimators full order prediction reduced order and current observers system identification optimal control linear quadratic regulator LQR linear quadratic Gaussian LQG estimator Kalman filter implementation of controllers and laboratory experiments for validation of analysis and design techniques on real laboratory scale hardware modules Both single input single output SISO and multi input multi output MIMO systems are covered Software platform of Matlab Simulink is used for analysis design and simulation and hardware software platforms of National Instruments NI LabVIEW are used for implementation and validation of analysis and design of digital control systems Demonstrating the use of an integrated approach to cover interdisciplinary topics of digital control emphasizing theoretical background validation through analysis simulation and implementation in physical laboratory experiments the book is ideal for students of engineering and applied science across a range of concentrations **Analog and Digital Control System Design** Chi-Tsong Chen, 2006-02-24 This text's contemporary approach focuses on the concepts of linear control systems rather than computational mechanics Straightforward coverage

includes an integrated treatment of both classical and modern control system methods The text emphasizes design with discussions of problem formulation design criteria physical constraints several design methods and implementation of compensators Discussions of topics not found in other texts such as pole placement model matching and robust tracking add to the text s cutting edge presentation Students will appreciate the applications and discussions of practical aspects including the leading problem in developing block diagrams noise disturbances and plant perturbations State feedback and state estimators are designed using state variable equations and transfer functions offering a comparison of the two approaches The incorporation of MATLAB throughout the text helps students to avoid time consuming computation and concentrate on control system design and analysis *Modern Control Engineering* P.N. Paraskevopoulos,2017-12-19

Illustrates the analysis behavior and design of linear control systems using classical modern and advanced control techniques Covers recent methods in system identification and optimal digital adaptive robust and fuzzy control as well as stability controllability observability pole placement state observers input output decoupling and model matching *Motion Vision* J. Kolodko,L. Vlacic,2005 This comprehensive book deals with motion estimation for autonomous systems from a biological algorithmic and digital perspective An algorithm which is based on the optical flow constraint equation is described in detail

Real-time Digital Signal Processing Sen-Maw Kuo,2003 *Control Theory* J.R. Leigh,2004 For students or professionals in science math or industry with or without a background in control theory explains and illustrates the basic concepts underlying the theory with references to more detailed treatments Intended as a companion to more traditional approaches begins with simple concepts such as feedback and stability and advances to optimization distributed parameter systems and other complex ideas Annotation copyrighted by Book News Inc Portland OR *Control Engineering Theory and Applications* Jahangir Alam,Guoqing Hu,Hafiz Md. Hasan Babu,Huazhong Xu,2022-11-17 The book provides general knowledge of automatic control engineering and its applications Providing an overview of control theory and systems the chapters introduce transfer functions modeling of control systems automatic control systems block diagrams and signal flow graphs While control system analysis and design are accompanied by root locus methods and frequency response analyses distributed control systems nonlinearity in control systems including Z transformation are also presented With straightforward demonstrations examples and multiple choice questions this book can be used as a reference textbook for electrical and electronics engineering computer control engineering automation engineering mechatronics engineering mechanics robotics AI control systems hydraulics process engineering safety control engineering aeronautical and aerospace engineering auto pilot system decision making system and stock exchange and will be suitable for majors non majors and experts in the field of science and technology **Modelling and Parameter Estimation of Dynamic Systems** J.R. Raol,G. Giriya,J. Singh,2004-08-13 This book presents a detailed examination of the estimation techniques and modeling problems The theory is furnished with several illustrations and computer programs to promote better understanding of system modeling and

parameter estimation **MATLAB/Simulink for Digital Communication** Won Y. Yang, 2018-03-02 Chapter 1 Fourier Analysis 1 1 1 CONTINUOUS TIME FOURIER SERIES CTFS 2 1 2 PROPERTIES OF CTFS 6 1 2 1 Time Shifting Property 6 1 2 2 Frequency Shifting Property 6 1 2 3 Modulation Property 6 1 3 CONTINUOUS TIME FOURIER TRANSFORM CTFT 7 1 4 PROPERTIES OF CTFT 13 1 4 1 Linearity 13 1 4 2 Conjugate Symmetry 13 1 4 3 Real Translation Time Shifting and Complex Translation Frequency Shifting 14 1 4 4 Real Convolution and Correlation 14 1 4 5 Complex Convolution Modulation Windowing 14 1 4 6 Duality 17 1 4 7 Parseval Relation Power Theorem 18 1 5 DISCRETE TIME FOURIER TRANSFORM DTFT 18 1 6 DISCRETE TIME FOURIER SERIES DFS DFT 19 1 7 SAMPLING THEOREM 21 1 7 1 Relationship between CTFS and DFS 21 1 7 2 Relationship between CTFT and DTFT 27 1 7 3 Sampling Theorem 27 1 8 POWER ENERGY AND CORRELATION 29 1 9 LOWPASS EQUIVALENT OF BANDPASS SIGNALS 30 Chapter 2 PROBABILITY AND RANDOM PROCESSES 39 2 1 PROBABILITY 39 2 1 1 Definition of Probability 39 2 1 2 Joint Probability and Conditional Probability 40 2 1 3 Probability Distribution Density Function 41 2 1 4 Joint Probability Density Function 41 2 1 5 Conditional Probability Density Function 41 2 1 6 Independence 41 2 1 7 Function of a Random Variable 42 2 1 8 Expectation Covariance and Correlation 43 2 1 9 Conditional Expectation 47 2 1 10 Central Limit Theorem Normal Convergence Theorem 47 2 1 11 Random Processes 49 2 1 12 Stationary Processes and Ergodic Processes 51 2 1 13 Power Spectral Density PSD 53 2 1 14 White Noise and Colored Noise 53 2 2 LINEAR FILTERING OF A RANDOM PROCESS 57 2 3 PSD OF A RANDOM PROCESS 58 2 4 FADING EFFECT OF A MULTIPATH CHANNEL 58 Chapter 3 ANALOG MODULATION 71 3 1 AMPLITUDE MODULATION AM 71 3 1 1 DSB Double Sideband AM Amplitude Modulation 71 3 1 2 Conventional AM Amplitude Modulation 75 3 1 3 SSB Single Sideband AM Amplitude Modulation 78 3 2 ANGLE MODULATION AGM FREQUENCY PHASE MODULATIONS 82 Chapter 4 ANALOG TO DIGITAL CONVERSION 87 4 1 QUANTIZATION 87 4 1 1 Uniform Quantization 88 4 1 2 Non uniform Quantization 89 4 1 3 Non uniform Quantization Considering the Absolute Errors 91 4 2 Pulse Code Modulation PCM 95 4 3 Differential Pulse Code Modulation DPCM 97 4 4 Delta Modulation DM 100 Chapter 5 BASEBAND TRANSMISSION 107 5 1 RECEIVER RCVR and SNR 107 5 1 1 Receiver of RC Filter Type 109 5 1 2 Receiver of Matched Filter Type 110 5 1 3 Signal Correlator 112 5 2 PROBABILITY OF ERROR WITH SIGNALING 114 5 2 1 Antipodal Bipolar Signaling 114 5 2 2 On Off Keying OOK Unipolar Signaling 118 5 2 3 Orthogonal Signaling 119 5 2 4 Signal Constellation Diagram 121 5 2 5 Simulation of Binary Communication 123 5 2 6 Multi Level amplitude PAM Signaling 127 5 2 7 Multi Dimensional Signaling 129 5 2 8 Bi Orthogonal Signaling 133 Chapter 6 BANDLIMITED CHANNEL AND EQUALIZER 139 6 1 BANDLIMITED CHANNEL 139 6 1 1 Nyquist Bandwidth 139 6 1 2 Raised Cosine Frequency Response 141 6 1 3 Partial Response Signaling Duobinary Signaling 143 6 2 EQUALIZER 148 6 2 1 Zero Forcing Equalizer ZFE 148 6 2 2 MMSE Equalizer MMSEE 151 6 2 3 Adaptive Equalizer ADE 154 6 2 4 Decision Feedback Equalizer DFE 155 Chapter 7 BANDPASS TRANSMISSION 169 7 1 AMPLITUDE SHIFT KEYING ASK 169 7 2 FREQUENCY SHIFT KEYING FSK 178 7 3 PHASE SHIFT

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People in Control Jan Noyes, Matthew Bransby, 2001-12-19 Drawn from a June 1999 conference of the same name 18 papers explore the role of human error in causing accidents and inefficiencies in automated processes and discuss engineering solutions to the design of systems and processes Emphasizing case studies and examples from the transport and process control industries the papers are organized into the topic areas of human performance methods and control room design Individual topics include situation awareness teamworking training for control room tasks allocation of human and machine functions task analysis development of a railway ergonomics control assessment package design of alarm systems control desks in power generation and integrated platform management system design for naval warships Annotation copyrighted by Book News Inc Portland OR

Quantitative Feedback Theory Constantine H. Houppis, Steven J. Rasmussen, Mario Garcia-Sanz, 2018-10-03 The first edition of Quantitative Feedback Theory gained enormous popularity by successfully bridging the gap between theory and real world engineering practice Avoiding mathematical theorems lemmas proofs and correlaries it boiled down to the essential elements of quantitative feedback theory QFT necessary to readily analyze develop and implement robust control systems Thoroughly updated and expanded Quantitative Feedback Theory Fundamentals and Applications Second Edition continues to provide a platform for intelligent decision making and design based on knowledge of the characteristics and

operating scenario of the plant Beginning with the fundamentals the authors build a background in analog and discrete time multiple input single output MISO and multiple input multiple output MIMO feedback control systems along with the fundamentals of the QFT technique The remainder of the book links these concepts to practical applications Among the many enhancements to this edition are a new section on large wind turbine control system four new chapters and five new appendices The new chapters cover non diagonal compensator design for MIMO systems QFT design involving Smith predictors for time delay systems with uncertainty weighting matrices and control authority and QFT design techniques applied to real world industrial systems Quantitative Feedback Theory Fundamentals and Applications Second Edition includes new and revised examples and end of chapter problems and offers a companion CD that supplies MIMO QFT computer aided design CAD software It is the perfect guide to effectively and intuitively implementing QFT control

Elements of Electromagnetics Matthew N. O. Sadiku, Sudarshan Nelatury, 2020-07-27 Using a vectors first approach Elements of Electromagnetics Seventh Edition covers electrostatics magnetostatics fields waves and applications like transmission lines waveguides and antennas The text also provides a balanced presentation of time varying and static fields preparing students for employment in today's industrial and manufacturing sectors *Optimal Estimation of Dynamic Systems* John L. Crassidis, John L. Junkins, 2011-10-26 An ideal self study guide for practicing engineers as well as senior undergraduate and beginning graduate students this book highlights the importance of both physical and numerical modeling in solving dynamics based estimation problems found in engineering systems such as spacecraft attitude determination GPS navigation orbit determination and aircraft tracking With more than 100 pages of new material this reorganized and expanded edition incorporates new theoretical results a new chapter on advanced sequential state estimation and additional examples and exercises MATLAB codes are available on the book's website **Flexible Robot Manipulators** M. Osman Tokhi, Abul K.M. Azad, 2008-05-20 This book discusses the latest developments in modelling simulation and control of flexible robot manipulators Coverage includes an overall review of previously developed methodologies a range of modelling approaches including classical techniques parametric and neuromodelling approaches and numerical modelling simulation techniques *Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, Second Edition* Robert B. Northrop, 2012-03-02 Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation Second Edition helps biomedical engineers understand the basic analog electronic circuits used for signal conditioning in biomedical instruments It explains the function and design of signal conditioning systems using analog ICs the circuits that enable ECG EEG EMG ERG tomographic images biochemical spectrograms and other crucial medical applications This book demonstrates how op amps are the keystone of modern analog signal conditioning system design and illustrates how they can be used to build instrumentation amplifiers active filters and many other biomedical instrumentation systems and subsystems It introduces the mathematical tools used to describe noise and its propagation

through linear systems and it looks at how signal to noise ratios can be improved by signal averaging and linear filtering
Features Analyzes the properties of photonic sensors and emitters and the circuits that power them Details the design of instrumentation amplifiers and medical isolation amplifiers Considers the modulation and demodulation of biomedical signals Examines analog power amplifiers including power op amps and class D switched PAs Describes wireless patient monitoring including Wi Fi and Bluetooth communication protocols Explores RFID GPS and ultrasonic tags and the design of fractal antennas Addresses special analog electronic circuits and systems such as phase sensitive rectifiers phase detectors and IC thermometers By explaining the building blocks of biomedical systems the author illustrates the importance of signal conditioning systems in the devices that gather and monitor patients critical medical information Fully revised and updated this second edition includes new chapters a glossary and end of chapter problems What s New in This Edition Updated and revised material throughout the book A chapter on the applications circuits and characteristics of power amplifiers A chapter on wireless patient monitoring using UHF telemetry A chapter on RFID tags GPS tags and ultrasonic tags A glossary to help you decode the acronyms and terms used in biomedical electronics physiology and biochemistry New end of chapter problems and examples

Classical Control System Kunal Chakraborty, 2016-04-15 The Temperature measurement of liquid in a tank can be controlled by classical and advance control algorithms applying PID FUZZY LOGIC SFB LQR Here we consider a three tank noninteracting system We observed that tank1 affects the dynamic behavior of tank2 Similarly tank2 affects the dynamic behavior of tank3 and vice versa because the flow rate F_1 depends on the difference between liquid levels h_1 and h_2 Thus a change in the inlet flowrate affects the liquid level in the tank which in turn affects the temperature of the liquid Basically it is a thermal process Various types of temperature sensors include RTD T C and Thermistor In this particular project the author used a mercury thermometer as sensor Mathematical models of the three tank method give a third order equation Each tank gives a transfer function of the first order system They make it easy to check whether a particular algorithm is giving the requisite results A lot of work has been carried out on the temperature control in terms of its stabilization Many attempts have been made to control the response of temperature measuring systems

Linear Control System Analysis and Design Constantine H. Houppis, Stuart N. Sheldon, John J. D'Azzo, 2003-08-14 Thoroughly classroom tested and proven to be a valuable self study companion Linear Control System Analysis and Design Fifth Edition uses in depth explanations diagrams calculations and tables to provide an intensive overview of modern control theory and conventional control system design The authors keep the mathematics to a minimum while stressing real world engineering challenges Completely updated and packed with student friendly features the Fifth Edition presents a wide range of examples using MATLAB and TOTAL PC as well as an appendix listing MATLAB functions for optimizing control system analysis and design Eighty percent of the problems presented in the previous edition have been revised to further reinforce concepts necessary for current electrical aeronautical astronautical and mechanical applications

Nonlinear and

Optimal Control Systems Thomas L. Vincent, Walter J. Grantham, 1997-06-23 Designed for one semester introductory senior or graduate level course the authors provide the student with an introduction of analysis techniques used in the design of nonlinear and optimal feedback control systems There is special emphasis on the fundamental topics of stability controllability and optimality and on the corresponding geometry associated with these topics Each chapter contains several examples and a variety of exercises

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