

# Digital Signal Processing using MATLAB

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### Chapter 5

**S.1** Consider the following first order IIR filter.

$$H(z) = \frac{.4(1 - z^{-1})}{1 + .2z^{-2}}$$

- (a) Compute and sketch the magnitude response  $A(f)$ .
- (b) What type of filter is this (lowpass, highpass, bandpass, bandstop)?
- (c) Suppose  $F_p = .4f_c$ . Find the passband ripple  $\delta_p$ .
- (d) Suppose  $F_s = .2f_c$ . Find the stopband attenuation  $\delta_s$ .

**Solution**

- (a) Using (S.2.1), the frequency response is

$$\begin{aligned} H(f) &= H(z)|_{z=e^{j2\pi fT}} \\ &= \frac{.4[1 - \exp(-j2\pi fT)]}{1 + .2 \exp(-j2\pi fT)} \\ &= \frac{.4[1 - \cos(2\pi fT) + j \sin(2\pi fT)]}{1 + .2 \cos(2\pi fT) - j.2 \sin(2\pi fT)} \end{aligned}$$

Thus the magnitude response is

# Chapter 3 Signal Processing Using Matlab

**Jorge Garza Ulloa**



### Chapter 3 Signal Processing Using Matlab:

**Academic Press Library in Signal Processing** Paulo S.R. Diniz,Patrick A. Naylor,Johan Suykens,2013-09-21 This first volume edited and authored by world leading experts gives a review of the principles methods and techniques of important and emerging research topics and technologies in machine learning and advanced signal processing theory With this reference source you will Quickly grasp a new area of research Understand the underlying principles of a topic and its application Ascertain how a topic relates to other areas and learn of the research issues yet to be resolved Quick tutorial reviews of important and emerging topics of research in machine learning Presents core principles in signal processing theory and shows their applications Reference content on core principles technologies algorithms and applications Comprehensive references to journal articles and other literature on which to build further more specific and detailed knowledge Edited by leading people in the field who through their reputation have been able to commission experts to write on a particular topic

**Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSK** Thad B. Welch,Cameron H.G. Wright,Michael G. Morrow,2005-12-21 From personal music players to anti lock brakes and advanced digital flight controllers the demand for real time digital signal processing DSP continues to grow Mastering real time DSP is one of the most challenging and time consuming pursuits in the field exacerbated by the lack of a resource that solidly bridges the gap between theory and practice Recognizing that there is a better way forward accomplished experts Welch Wright and Morrow offer Real Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSK This book collects all of the necessary tools in a single field tested source of unrivaled authority The authors seamlessly integrate theory with easy to use inexpensive hardware and software tools in an approachable and hands on manner Using abundant examples and exercises in a step by step approach they work from familiar interfaces such as MATLAB to running algorithms in real time on industry standard DSP hardware For each concept the book uses a four step methodology a brief review of relevant theory demonstration of the concept in winDSK6 an easy to use software tool explanation and demonstration of MATLAB techniques for implementation and explanation of the necessary C code to implement the algorithms in real time Covering a broad spectrum of topics in a hands on concise and approachable way Real Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSK paves the way toward mastery of real time DSP Essential source code is available for download

**Computer-based Exercises for Signal Processing Using MATLAB 5** James H. McClellan,1998 For senior or introductory graduate level courses in digital signal processing Developed by a group of six eminent scholars and teachers this book offers a rich collection of exercises and projects which guide students in the use of MATLAB v5 to explore major topical areas in digital signal processing

*Digital Signal Processing Using MATLAB V.4* Vinay K. Ingle,John G. Proakis,1997 Intended to supplement traditional references on digital signal processing DSP for readers who wish to make MATLAB an integral part of DSP this text covers such topics as Discrete time signals and systems Discrete time Fourier

analysis the z Transform the Discrete Fourier Transform digital filter structures FIR filter design IIR filter design and more

*Computer-based Exercises for Signal Processing Using MATLAB* C. S. Burrus,1994      **Signal Processing Toolbox for Use with MATLAB** MathWorks, Inc,2002      **Network Modeling, Simulation and Analysis in MATLAB** Dac-Nhuong Le,Abhishek Kumar Pandey,Sairam Tadepalli,Pramod Singh Rathore,Jyotir Moy Chatterjee,2019-09-11 The purpose of this book is first to study MATLAB programming concepts then the basic concepts of modeling and simulation analysis particularly focus on digital communication simulation The book will cover the topics practically to describe network routing simulation using MATLAB tool It will cover the dimensions like Wireless network and WSN simulation using MATLAB then depict the modeling and simulation of vehicles power network in detail along with considering different case studies Key features of the book include Discusses different basics and advanced methodology with their fundamental concepts of exploration and exploitation in NETWORK SIMULATION Elaborates practice questions and simulations in MATLAB Student friendly and Concise Useful for UG and PG level research scholar Aimed at Practical approach for network simulation with more programs with step by step comments Based on the Latest technologies coverage of wireless simulation and WSN concepts and implementations      **Digital Signal and Image Processing Using MATLAB** Gerard Blanchet,Maurice Charbit,2006-05-22 This title provides the most important theoretical aspects of Image and Signal Processing ISP for both deterministic and random signals The theory is supported by exercises and computer simulations relating to real applications More than 200 programs and functions are provided in the MATLAB language with useful comments and guidance to enable numerical experiments to be carried out thus allowing readers to develop a deeper understanding of both the theoretical and practical aspects of this subject      Digital Signal Processing Kaluri V. Rangarao,Ranjan K. Mallik,2006-02-22 Digital signal processing is essential for improving the accuracy and reliability of a range of engineering systems including communications networking and audio and video applications Using a combination of programming and mathematical techniques it clarifies or standardizes the levels or states of a signal in order to meet the demands of designing high performance digital hardware Written by authors with a wealth of practical experience working with digital signal processing this text is an excellent step by step guide for practitioners and researchers needing to understand and quickly implement the technology Split into six self contained chapters Digital Signal Processing A Practitioner s Approach covers basic principles of signal processing such as linearity stability convolution time and frequency domains and noise descriptions of digital filters and their realization including fixed point implementation pipelining and field programmable gate array FPGA implementation Fourier transforms especially discrete DFT and fast Fourier transforms FFT case studies demonstrating difference equations direction of arrival DoA and electronic rotating elements and MATLAB programs to accompany each chapter A valuable reference for engineers developing digital signal processing applications this book is also a useful resource for electrical and computer engineering graduates taking courses in signal processing      *Digital Signal Processing Implementations* Avtar Singh,Srini

Srinivasan,2004 Whether you are an engineering student or an engineer already engaged in system design this current book will become your essential companion guiding you in using both hardware and software as you design systems with programmable DSP devices Jacket *Signal Processing Algorithms in MATLAB* Samuel D. Stearns,Ruth A. David,1996 MATLAB is the current hot language in signal processing This book disk package deals the basic algorithms of digital signal processing and is written around a set of over 50 MATLAB function m files each of which is included on the disk Emphasizes the application as opposed to the theory of digital signal processing covering discrete Fourier transforms spectral analysis the frequency and time domain response of linear systems digital IIR and FIR filtering fast convolution and correlation algorithms least squares design adaptive signal processing and statistical parameters For signal processing engineers

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Student Manual for Digital Signal Processing with MATLAB John G. Proakis, Vinay K. Ingle, 2007     A Self-study Guide for Digital Signal Processing John G. Proakis, Vinay K. Ingle, 2004     **Applied Biomechanics Using Mathematical Models** Jorge Garza Ulloa, 2018-06-16 Applied Biomechanics Using Mathematical Models provides an appropriate methodology to detect and measure diseases and injuries relating to human kinematics and kinetics It features mathematical models that when applied to engineering principles and techniques in the medical field can be used in assistive devices that work with bodily signals The use of data in the kinematics and kinetics analysis of the human body including musculoskeletal kinetics and joints and their relationship to the central nervous system CNS is covered helping users understand how the complex network of symbiotic systems in the skeletal and muscular system work together to allow movement controlled by the CNS With the use of appropriate electronic sensors at specific areas connected to bio instruments we can obtain enough information to create a mathematical model for assistive devices by analyzing the kinematics and kinetics of the human body The mathematical models developed in this book can provide more effective devices for use in aiding and improving the function of the body in relation to a variety of injuries and diseases Focuses on the mathematical modeling of human kinematics and kinetics Teaches users how to obtain faster results with these mathematical models Includes a companion website with additional content that presents MATLAB examples     **MATLAB/Simulink for Digital Signal Processing** Won Y. Yang, 2015-03-02 Chapter 1 Fourier Analysis 1 1 1 CTFS CTFT DTFT AND DFS DFT 1 1 2 SAMPLING THEOREM 16 1 3 FAST FOURIER TRANSFORM FFT 19 1 3 1 Decimation in Time DIT FFT 19 1 3 2 Decimation in Frequency DIF FFT 22 1 3 3 Computation of IDFT Using FFT Algorithm 23 1 4 INTERPRETATION OF DFT RESULTS 23 1 5 EFFECTS OF SIGNAL OPERATIONS ON DFT SPECTRUM 31 1 6 SHORT TIME FOURIER TRANSFORM STFT 32 Chapter 2 System Function Impulse Response and Frequency Response 51 2 1 THE INPUT OUTPUT RELATIONSHIP OF A DISCRETE TIME LTI SYSTEM 52 2 1 1 Convolution 52 2 1 2 System Function and Frequency Response 54 2 1 3 Time Response 55 2 2 COMPUTATION OF LINEAR CONVOLUTION USING DFT 55 2 3 PHYSICAL MEANING OF SYSTEM FUNCTION AND FREQUENCY RESPONSE 58 Chapter 3 Correlation and Power Spectrum 73 3 1 CORRELATION SEQUENCE 73 3 1 1 Crosscorrelation 73 3 1 2 Autocorrelation 76 3 1 3 Matched Filter 80 3 2 POWER SPECTRAL DENSITY PSD 83 3 2 1 Periodogram PSD Estimator 84 3 2 2 Correlogram PSD Estimator 85 3 2 3 Physical Meaning of Periodogram 85 3 3 POWER SPECTRUM FREQUENCY RESPONSE AND COHERENCE 89 3 3 1 PSD and Frequency Response 90 3 3 2 PSD and Coherence 91 3 4 COMPUTATION OF CORRELATION USING DFT 94 Chapter 4 Digital Filter Structure 99 4 1

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