

Design Digital Non-Recursive FIR Filter by Using Exponential Window

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ABSTRACT

One of the most effective variables is the far-end stopband attenuation especially when the signal needed to be filtered has a great concentration of spectral energy. In a sub-band coding, the filter is intended to separate out various frequency bands for independent processing. When it is applied on speech, the far-end rejection of the energy in the stopband needs to be as higher as possible to make leakage of the energy from one band to another as lower as possible. Therefore, the designed filter should have special specifications which should provide better far-end stopband attenuation (amplitude of last ripple in stopband). Finding a digital filter that has a higher performance far-end stopband attenuation than Kaiser Window is very valuable when the FIR filter constructed by the use of Kaiser Window far-end stopband attenuation becomes better than the one constructed by the well-known adjustable windows, for instance, the special cases of Ultra-spherical windows, Dolph-Chebyshev and Saramaki.

In this paper, the design of digital non-recursive finite impulse response (FIR) filter by using Exponential window is proposed. Also, the construction of non-recursive digital FIR filter has been presented through applying Exponential window. After applying the Exponential window, it is found that the far-end stopband attenuation becomes better than the filter constructed by Kaiser window, and that is one of the advantages of filter building by using Exponential window over Kaiser window. The proposed scheme is simulated by MATLAB. All the simulation results show a good agreement with the proposed theory.

Keywords: Digital FIR Filter, Side-lobe Roll-off Ratio, Far-end Stopband Attenuation, Window Technique, Exponential Window

INTRODUCTION

A more comprehensive view of the truncation and smoothing operations is in terms of window functions (or windows for short). Windows are normally compared and classified into different types according to their spectral characteristics. Window functions have been widely used in various digital signal processing (DSP) applications such as signal analysis, signal estimation, digital filter design and speech processing [1][2].

Various windows have been proposed to achieve the desired solutions [3][4][2][5]. Cosine hyperbolic function is one of them [6]. The idea of this window is based on the Kaiser window, but it has an advantage since there is no expanding in the power series in the time domain representation. This window gives a better ripple ratio for wider main lobe width and larger side lobe roll-off ratio along with the ultra-spherical comparison. When its function is merged with the Hamming window, it produces a better performance in terms of the ripple ratio, better than a same margin of a Kaiser and Hamming windows. Another method to design ultra-spherical window functions in order to reach prescribed spectral characteristics can be found in [4]. This method is made of combining various techniques basically to measure the ultra-spherical window, independent parameters which are ripple ratio and main-lobe width or null-to-null width along with a user-defined side-lobe pattern can also be reached. A simple comparison has been made between the ultra-spherical and Kaiser Windows and the result of this comparison showed that there is a difference in the performance which depends on the required specifications [14].

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Digital Signal Processing N. B. Jones, J. D. McK. Watson, 1990 This volume presents the fundamentals of data signal processing ranging from data conversion to z transforms and spectral analysis In addition to presenting basic theory and describing the devices the material is complemented by real examples in specific case studies Proceedings of the International Conference on Information Systems Design and Intelligent Applications 2012 (India 2012) held in Visakhapatnam, India, January 2012 Suresh Chandra Satapathy, P S Avadhani, Ajith Abraham, 2011-12-14 This volume contains the papers presented at INDIA 2012 International conference on Information system Design and Intelligent Applications held on January 5 7 2012 in Vishakhapatnam India This conference was organized by Computer Society of India CSI Vishakhapatnam chapter well supported by Vishakhapatnam Steel RINL Govt of India It contains 108 papers contributed by authors from six different countries across four continents These research papers mainly focused on intelligent applications and various system design issues The papers cover a wide range of topics of computer science and information technology discipline ranging from image processing data base application data mining grid and cloud computing bioinformatics among many others The various intelligent tools like swarm intelligence artificial intelligence evolutionary algorithms bio inspired algorithms have been applied in different papers for solving various challenging IT related problems

Evolutionary Computing and Mobile Sustainable Networks V. Suma, Nouredine Bouhmala, Haoxiang Wang, 2020-07-31 This book features selected research papers presented at the International Conference on Evolutionary Computing and Mobile Sustainable Networks ICECMSN 2020 held at the Sir M Visvesvaraya Institute of Technology on 20 21 February 2020 Discussing advances in evolutionary computing technologies including swarm intelligence algorithms and other evolutionary algorithm paradigms which are emerging as widely accepted descriptors for mobile sustainable networks virtualization optimization and automation this book is a valuable resource for researchers in the field of evolutionary computing and mobile sustainable networks Modern Digital Signal Processing V. Udayashankara, 2016-02-29 Intended as a text for three courses Signals and Systems Digital Signal Processing DSP and DSP Architecture this comprehensive book now in its Third Edition continues to provide a thorough understanding of digital signal processing beginning from the fundamentals to the implementation of algorithms on a digital signal processor This Edition includes Assembly C and real time C programs for TMS 320C54XX and 320C6713 processor which are useful to conduct a laboratory course in Digital Signal Processing Besides many existing chapters are modified substantially to widen the coverage of the book Primarily designed for undergraduate students of Electronics and Communication Engineering Electronics and Instrumentation Engineering Electrical and Electronics Engineering Instrumentation and Control Engineering Computer Science and Information Science this text will also be useful for advanced digital signal processing and real time digital signal processing courses of postgraduate programmes *Listening in the Ocean* Whitlow W. L. Au, Marc O. Lammers, 2016-02-25 This title

brings to light the discoveries and insights into the lives of many marine species made possible over the last decade by passive acoustic recorders PAR Pop ups ARF HARP EAR Bprobe C POD Atag and Dtag are the acronyms of some of the many PARs that have changed our understanding of how marine animals live and strive in the ocean Various types of PARs are used by different investigators in different areas of the world These recorders have accumulated copious amounts of very important data unveiling previously unknown information about large marine animals Temporal seasonal and spatial distribution patterns have been uncovered for many marine species There have been many discoveries new understandings and insights into how these animals live in and utilize the ocean and the importance of acoustics in their lives Listening Within the Ocean summarizes these important discoveries providing both a valuable resource for researchers and enjoyable reading for non professionals interested in marine life *Digital Signal Processing and Applications* Dag Stranneby, 2004-09-10 A uniquely practical DSP text this book gives a thorough understanding of the principles and applications of DSP with a minimum of mathematics and provides the reader with an introduction to DSP applications in telecoms control engineering and measurement and data analysis systems The new edition contains Expanded coverage of the basic concepts to aid understanding New sections on filter synthesis control theory and contemporary topics of speech and image recognition Full solutions to all questions and exercises in the book Assuming the reader already has some prior knowledge of signal theory this textbook will be highly suitable for undergraduate and postgraduate students in electrical and electronic engineering taking introductory and advanced courses in DSP as well as courses in communications and control systems engineering It will also prove an invaluable introduction to DSP and its applications for the professional engineer Expanded coverage of the basic concepts to aid understanding along with a wide range of DSP applications New textbook features included throughout including learning objectives summary sections exercises and worked examples to increase accessibility of the text Full solutions to all questions and exercises included in the book **MATLAB** KUMAR, S. SWAPNA, LENINA, S V B, 2016-01-30 MATLAB Easy Way of Learning covers exactly what students need to know in an introductory course This comprehensive book helps reader in understanding all the aspects of MATLAB basics and applications in an easy way The authors explain concepts by balanced treatment of theoretical and practical concepts with easy to understand programming codes and executions The book is suitable for the postgraduate and undergraduate students of engineering and sciences streams KEY FEATURES Includes sufficient numbers of examples and illustrations Blends self contained and reader friendly approach for teaching the concepts related to Simulink Fuzzy Logic Neural Network and Signal and Image Processing Covers wide ideas of applications through systematic and sequentially planned organized chapters Introduces MATLAB functions and other special functions with the help of worked out programs Provides Summary of the presented features Review questions and Practice exercise at the end of each chapter that will reinforce the concepts Explains concepts with the help of screenshots of the MATLAB software *Passive, Active, and Digital Filters*

Wai-Kai Chen, 2018-10-08 Upon its initial publication *The Circuits and Filters Handbook* broke new ground. It quickly became the resource for comprehensive coverage of issues and practical information that can be put to immediate use. Not content to rest on his laurels in addition to updating the second edition, editor Wai Kai Chen divided it into tightly focused texts that made the information easily accessible and digestible. These texts have been revised, updated, and expanded so that they continue to provide solid coverage of standard practices and enlightened perspectives on new and emerging techniques. *Passive, Active, and Digital Filters* provides an introduction to the characteristics of analog filters and a review of the design process and the tasks that need to be undertaken to translate a set of filter specifications into a working prototype. Highlights include discussions of the passive cascade synthesis and the synthesis of LCM and RC one-port networks; a summary of two-port synthesis by ladder development; a comparison of the cascade approach, the multiple loop feedback topology, and ladder simulations; an examination of four types of finite wordlength effects; and coverage of methods for designing two-dimensional finite extent impulse response (FIR) discrete-time filters. The book includes coverage of the basic building blocks involved in low and high order filters, limitations, and practical design considerations, and a brief discussion of low-voltage circuit design. Revised Chapters: Sensitivity and Selectivity, Switched Capacitor Filters, FIR Filters, IIR Filters, VLSI Implementation of Digital Filters, Two-Dimensional FIR Filters. Additional Chapters: 1-D Multirate Filter Banks, Directional Filter Banks, Nonlinear Filtering Using Statistical Signal Models, Nonlinear Filtering for Image Denoising, Video Demosaicking, Filters. This volume will undoubtedly take its place as the engineer's first choice in looking for solutions to problems encountered when designing filters.

DIGITAL SIGNAL PROCESSING, Second Edition KUMAR, A. ANAND, 2014-12-15 The second edition of this well-received text continues to provide coherent and comprehensive coverage of digital signal processing. It is designed for undergraduate students of Electronics and Communication engineering, Telecommunication engineering, Electronics and Instrumentation engineering, Electrical and Electronics engineering, Electronics and Computers engineering, Biomedical engineering, and Medical Electronics engineering. This book will also be useful to AMIE and IETE students. Written with a student-centred, pedagogically driven approach, the text provides a self-contained introduction to the theory of digital signal processing. It covers topics ranging from basic discrete-time signals and systems, discrete convolution and correlation, Z-transform and its applications, realization of discrete-time systems, discrete-time Fourier transform, discrete Fourier series, discrete Fourier transform to fast Fourier transform. In addition to this, various design techniques for design of IIR and FIR filters are discussed. Multi-rate digital signal processing and introduction to digital signal processors and finite word length effects on digital filters are also covered. All the solved and unsolved problems in this book are designed to illustrate the topics in a clear way. MATLAB programs and the results for typical examples are also included at the end of chapters for the benefit of the students. New to This Edition: A chapter on Finite Word Length Effects in Digital Filters. Key Features: Numerous worked-out examples in each chapter. Short questions with answers help students to prepare for examinations and interviews.

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Signal Processing for Radiation Detectors Mohammad Nakhostin, 2017-10-05 Presents the fundamental concepts of signal processing for all application areas of ionizing radiation This book provides a clear understanding of the principles of signal processing of radiation detectors It puts great emphasis on the characteristics of pulses from various types of detectors and offers a full overview on the basic concepts required to understand detector signal processing systems and pulse processing techniques Signal Processing for Radiation Detectors covers all of the important aspects of signal processing including energy spectroscopy timing measurements position sensing pulse shape discrimination and radiation intensity measurement The book encompasses a wide range of applications so that readers from different disciplines can benefit from all of the information In addition this resource Describes both analog and digital techniques of signal processing Presents a complete compilation of digital pulse processing algorithms Extrapolates content from more than 700 references covering classic papers as well as those of today Demonstrates concepts with more than 340 original illustrations Signal Processing for Radiation Detectors provides researchers engineers and graduate students working in disciplines such as nuclear physics and engineering environmental and biomedical engineering and medical physics and radiological science the knowledge to design their own systems optimize available systems or to set up new experiments

Digital Filters Using MATLAB Lars Wanhammar, Tapio Saramäki, 2020-02-18 This textbook provides comprehensive coverage for courses in the basics of design and implementation of digital filters The book assumes only basic knowledge in digital signal processing and covers state of the art methods for digital filter design and provides a simple route for the readers to design their own filters The advanced mathematics that is required for the filter design is minimized by providing an extensive MATLAB toolbox with over 300 files The book presents over 200 design examples with MATLAB code and over 300 problems to be solved by the reader The students can design and modify the code for their use The book and the design examples cover almost all known design methods of frequency selective digital filters as well as some of the authors own unique techniques

Communication System Design Using DSP Algorithms Steven A. Tretter, 2012-12-06 Designed for senior electrical engineering students this textbook explores the theoretical concepts of digital signal processing and communication systems by presenting laboratory experiments using real time DSP hardware The experiments are designed for the Texas Instruments TMS320C6701 Evaluation Module or TMS320C6711 DSK but can easily be adapted to other DSP boards Each chapter begins with a presentation of the required theory and concludes with instructions for performing experiments to implement the theory In the process of performing the experiments students gain experience in working with software tools and equipment commonly used in industry

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Intelligent Computing in Engineering Vijender Kumar Solanki, Manh Kha Hoang, Zhonghyu (Joan) Lu, Prasant Kumar Pattnaik, 2020-04-09 This book comprises select papers from the international conference on Research in Intelligent and Computing in Engineering RICE 2019 held at Hanoi University of Industry Hanoi Vietnam The volume focuses on current research on various computing models such as centralized distributed cluster grid and cloud The contents cover recent advances in wireless sensor networks mobile ad hoc networks internet of things machine learning grid and cloud computing and their various applications The book will help researchers as well as professionals to gain insight into the rapidly evolving fields of internet computing and data mining

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Electrical Engineering and Control Min Zhu, 2011-06-21 This volume includes extended and revised versions of a set of selected papers from the International Conference on Electric and Electronics EEIC 2011 held on June 20 22 2011 which is jointly organized by Nanchang University Springer and IEEE IAS Nanchang Chapter The objective of EEIC 2011 Volume 2 is to provide a major interdisciplinary forum for the presentation of new approaches from Electrical

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Digital Signal Processing Muhammad Khan, Syed K. Hasnain, Mohsin Jamil, 2022-09-01 The subject of Digital Signal Processing DSP is enormously complex involving many concepts probabilities and signal processing that are woven together in an intricate manner To cope with this scope and complexity many DSP texts are often organized around the numerical examples of a communication system With such organization readers can see through the complexity of DSP they learn about the distinct concepts and protocols in one part of the communication system while seeing the big picture of how all parts fit together From a pedagogical perspective our personal experience has been that such approach indeed works well Based on the authors extensive experience in teaching and research Digital Signal Processing a breadth first approach is written with the reader in mind The book is intended for a course on digital signal processing for seniors and undergraduate students The subject has high popularity in the field of electrical and computer engineering and the authors consider all the needs and tools used in analysis and design of discrete time systems for signal processing Key features of the book include The extensive use of MATLAB based examples to illustrate how to solve signal processing problems The textbook includes a wealth of problems with solutions Worked out examples have been included to explain new and difficult concepts which help to expose the reader to real life signal processing problems The inclusion of FIR and IIR filter design further enrich the contents

Digital Filters and Signal Processing Fausto Pedro García Márquez, Noor Zaman, 2013-01-16 Digital filters together with signal processing are being employed in the new technologies and information systems and are implemented in different areas and applications Digital filters and signal processing are used with no costs and they can be adapted to different cases with great flexibility and reliability This book presents advanced developments in digital filters and signal process methods covering different cases studies They present the main essence of the subject with the principal approaches to the most recent mathematical models that are being employed worldwide

Signal Processing and Integrated Circuits Hussein Baher, 2012-04-23 This book provides a balanced account of analog digital and mixed mode signal processing with applications in telecommunications Part I Perspective gives an overview of the areas of Systems on a Chip Soc and mobile communication which are used to demonstrate the complementary relationship between analog and digital systems Part II Analog continuous time and Digital Signal Processing contains both fundamental and advanced analysis and design techniques of analog and digital systems This includes analog and digital filter design fast Fourier transform FFT algorithms stochastic signals linear estimation and adaptive filters Part III Analog MOS Integrated Circuits for Signal Processing covers basic MOS transistor operation and fabrication through to the design of complex integrated circuits such as high performance Op Amps Operational

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Trends in Digital Signal Processing Yong Ching Lim,Hon Keung Kwan,Wan-Chi Siu,2015-07-24 Digital signal processing is ubiquitous It is an essential ingredient in many of today s electronic devices ranging from medical equipment to weapon systems It makes the difference between dumb and intelligent systems This book is organized into five parts 1 Introduction which contains an account of Prof Constantinides contribution to the

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Table of Contents Design Digital Non Recursive Fir Filter By Using

1. Understanding the eBook Design Digital Non Recursive Fir Filter By Using
 - The Rise of Digital Reading Design Digital Non Recursive Fir Filter By Using
 - Advantages of eBooks Over Traditional Books
2. Identifying Design Digital Non Recursive Fir Filter By Using
 - 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 Design Digital Non Recursive Fir Filter By Using
 - User-Friendly Interface
4. Exploring eBook Recommendations from Design Digital Non Recursive Fir Filter By Using

- Personalized Recommendations
 - Design Digital Non Recursive Fir Filter By Using User Reviews and Ratings
 - Design Digital Non Recursive Fir Filter By Using and Bestseller Lists
5. Accessing Design Digital Non Recursive Fir Filter By Using Free and Paid eBooks
 - Design Digital Non Recursive Fir Filter By Using Public Domain eBooks
 - Design Digital Non Recursive Fir Filter By Using eBook Subscription Services
 - Design Digital Non Recursive Fir Filter By Using Budget-Friendly Options
 6. Navigating Design Digital Non Recursive Fir Filter By Using eBook Formats
 - ePub, PDF, MOBI, and More
 - Design Digital Non Recursive Fir Filter By Using Compatibility with Devices
 - Design Digital Non Recursive Fir Filter By Using Enhanced eBook Features
 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Design Digital Non Recursive Fir Filter By Using
 - Highlighting and Note-Taking Design Digital Non Recursive Fir Filter By Using
 - Interactive Elements Design Digital Non Recursive Fir Filter By Using
 8. Staying Engaged with Design Digital Non Recursive Fir Filter By Using
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Design Digital Non Recursive Fir Filter By Using
 9. Balancing eBooks and Physical Books Design Digital Non Recursive Fir Filter By Using
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Design Digital Non Recursive Fir Filter By Using
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Design Digital Non Recursive Fir Filter By Using
 - Setting Reading Goals Design Digital Non Recursive Fir Filter By Using
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Design Digital Non Recursive Fir Filter By Using

- Fact-Checking eBook Content of Design Digital Non Recursive Fir Filter By Using
- 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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