

Introduction to Digital Filters

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Introduction to Digital Filters

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To Jennifer, Janet and Lesley

Contents

<i>Preface</i>	ix
1 Introduction	1
1.1 Background to Digital Filters	1
1.2 Sampled-data Signals	3
1.3 The Z -transform	6
1.4 Method of Determining Z -transforms from Laplace Transforms	21
1.5 The Inverse Z - transform	23
1.6 The Digital Filter Transfer Function	26
1.7 The Discrete Fourier Transform	32
1.8 The Fast Fourier Transform	34
1.9 Concluding Remarks	37
2 Design of Recursive Digital Filters	40
2.1 Introduction	40
2.2 Indirect Approach using Prototype Continuous Filter	41
2.3 Frequency Sampling Filters	68
2.4 Direct Approach using Squared Magnitude Function	77
2.5 Wave-shaping Filters	80
3 Design of Non-recursive Digital Filters	89
3.1 Introduction	89
3.2 Frequency-domain Design using Window Functions	90
3.3 Equiripple Approximation Method	95
3.4 An Analytical Technique for Designing FIR Filters	100
3.5 Time-domain Design of the Digital Transversal Filter	109

4	Quantisation Considerations in Digital Filter Implementation	112
4.1	Introduction	112
4.2	Binary Number Representations	113
4.3	Quantisation of the Digital Filter Input Signal	117
4.4	Realisation Structure Considerations	121
4.5	Limit Cycle Oscillations	139
4.6	Overflow Oscillations	143
4.7	Concluding Remarks	145
5	Practical Implementation of Digital Filters	148
5.1	Introduction	148
5.2	Implementation using Dedicated Hardware	148
5.3	Implementation using Digital Computers	164
5.4	Signals and Noise	186
5.5	Concluding Remarks	193
	<i>Appendixes to Chapter 5</i>	194
	<i>Answers to Problems</i>	212
	<i>Index</i>	215

Preface

In the 1970s computer technology has progressed at a phenomenal rate and, as microprocessor systems continue to develop, the cost of implementing digital signal processors will, hopefully, correspondingly decrease. Consequently in the 1980s it is expected that the number of practical applications of digital filters will significantly increase; furthermore it is possible that many established continuous-time filter systems will be replaced by equivalent digital filter systems. There is therefore a growing need for more well-trained engineering and science graduates, postgraduates and practising engineers who are skilled in the design and implementation of digital filter systems. Fortunately many polytechnics and universities have already recognised the importance of digital signal processing, and this subject now generally forms part of the core material in many undergraduate and postgraduate engineering courses.

This book presents a concise introduction to the fundamental techniques involved in the design and implementation of digital filters. The level of the information presented makes it suitable for use mainly in the second and the final years of electrical and electronic engineering undergraduate courses. Some of the material goes beyond the undergraduate level and will be useful to postgraduate students and practising engineers. The book includes many appropriate worked examples which serve to illustrate theoretical concepts as they are developed in the text. Indeed, the main purpose of the worked examples is to help to bridge the gap between the theoretical and practical aspects of digital filters, and it is intended that this feature will greatly assist the reader (especially the undergraduate student) in relating the theory to practical results.

The first chapter introduces sampled-data signals and systems, and the basic required mathematical concepts of the Z -transform and the inverse Z -transform are developed. In chapter 2 a number of useful design methods applicable to recursive digital filters are described in detail. The design methods applicable to non-recursive digital filters are examined in chapter 3. The main considerations that must be given to quantisation effects in the practical implementation of digital filters are discussed in chapter 4. In chapter 5 (the final chapter) hardware and software aspects of digital filter implementation are discussed in detail, and

some pertinent microprocessor system concepts are described. The appendixes at the end of the book have been included to help the reader who wishes to undertake the task of translating a 'paper design' into a practical working digital filter. Typically the latter may be a project for the undergraduate student, or indeed in some cases a postgraduate student, or project development undertaken by the practising engineer.

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TREVOR J. TERRELL