

Contents

1	Digital Signal Processing Development System	1
1.1	Introduction	1
1.2	Testing the Software Tools	3
1.3	Testing the Hardware Tools	10
	References	15
2	The TMS320C30 Digital Signal Processor	17
2.1	Introduction	17
2.2	TMS320C30 Architecture and Memory Organization	18
2.3	Memory Addressing Modes	22
2.4	TMS320C30 Instruction Set	23
2.5	Data and Floating-Point Formats	28
2.6	Programming Examples Using both C and TMS320C30 Code with the Simulator	30
	References	48
3	Alternative Input/Output and Extended Development System	50
3.1	Introduction	31
3.2	The Analog Interface Chip	52
3.3	Interrupts	56
3.4	Programming Examples	57
3.5	PC-Host-TMS320C30 Communication	82

X Contents

3.6 Burr-Brown Two-Channel Analog Evaluation Fixture	87
3.7 Texas Instruments' Analog Interface Board	88
3.8 Extended Development System XDS1000 Emulator	88
References	89
4 Finite Impulse Response Filters	90
4.1 Introduction to the Z-Transform	91
4.2 Discrete Signals	96
4.3 Finite Impulse Response Filters	97
4.4 FIR Lattice Structure	99
4.5 FIR Implementation Using Fourier Series	103
4.6 Window Functions	106
4.7 Filter Design Packages	109
4.8 Programming Examples Using C and TMS320C30 Code	110
4.9 Filter Development Package (FDP) and Digital Filter Design Package (DFDP)	139
References	150
5 Infinite Impulse Response Filters	153
5.1 Introduction	153
5.2 IIR Filter Structures	155
5.3 Bilinear Transformation	166
5.4 Utility Programs for BLT and Magnitude and Phase Responses	170
5.5 Programming Examples Using C and TMS320C30 Code	174
References	195
6 Fast Fourier Transform	197
6.1 Introduction	197
6.2 Development of the FFT Algorithm: Radix-2	198
6.3 Decimation-in-Frequency FFT Algorithm	199
6.4 Decimation-in-Time FFT Algorithm	205
6.5 Bit Reversal for Unscrambling	209
6.6 Development of the FFT Algorithm: Radix-4 DIF	211
6.7 Inverse Fast Fourier Transform	215
6.8 Fast Hartley Transform	215
6.9 FFT Programming Examples Using C and TMS320C30 Code	222
References	233

7 Adaptive Filters	236
7.1 Introduction	236
7.2 Adaptive Structures	238
7.3 Linear Adaptive Combiner and the LMS Algorithm	239
7.4 Programming Examples Using C and TMS320C30 Code	242
References	267
8 Real-Time Digital Signal Processing Applications with C and the TMS320C30: Student Projects	269
8.1 Parametric Equalizer	269
8.2 Adaptive Notch Filter Using TMS320C30 Code	274
8.3 Adaptive Filter for Noise Cancellation Using C Code	279
8.4 Swept Frequency Response	287
8.5 Multirate Filter	291
8.6 Introduction to Image Processing: Video Line Rate Analysis	301
8.7 PID Controller	310
8.8 Wireguided Submersible	318
8.9 Frequency Shift Using Modulation	320
8.10 Four-Channel Multiplexer for Fast Data Acquisition	321
8.11 Neural Network for Signal Recognition	324
References	328
A Introduction to C Programming	331
B Instruction Set, Registers, and Memory Maps	340
B.1 TMS320C30 Instruction Set	340
B.2 Register Formats and Memory Maps	340
C Digital Signal Processing Tools	353
C.2 Time and Frequency Domain Utilities	354
C.3	359
C.4 JIR Filter Design and Code Generation	366
D Burr-Brown Analog Evaluation Fixture	373
D.1 Testing Channel A Using Polling	375
D.2 Testing Both Channels Using Polling	375
D.3 Testing Channel A Using Interrupt	375

xii Contents

D.4 Testing Channels A and B Using Interrupt	376
D.5 Burr-Brown Communication Routines	379
E Extended Development System	380
E.1 The XDS1000 Emulator	380
F Programs for Multirate Filter and Video Line Rate Analysis Projects	390
F.1 Multirate Filter Program	390
F.2 Video Module Parts List	390
F.3 Supporting Programs for Video Line Rate Analysis	408
Index	409