A new textbook to be published by Prentice-Hall

DSP System Design:

Based on TI Data Converters and TMS320C6000

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Digital Signal Processing has experienced an enormous growth in the last twenty years. Nowadays DSP systems, such as cell phones and high-speed modems, have become an integral part of our lives. The two major components of DSP systems are DSP processors and analog-to-digital/digital-to-analog data converters. DSP processors are expected to play a major role in the next generation of high speed communication systems and networks. The TMS320C6000 processor family has been introduced by Texas Instruments to meet such high performance demands.

This book has evolved from teaching a DSP laboratory course at Texas A&M University. The objective of this book is twofold: (a) to provide DSP system designers with the knowledge needed to select an appropriate data converter for a specific DSP system of interest, (b) to provide the know-how for the implementation and optimization of computationally intensive signal processing algorithms on the family of TMS320C6x DSP processors. The book is also written for the purpose of providing a textbook for a real-time DSP laboratory course using the TMS320C6x DSP. Such a course is meant to be a follow-up to a first course in DSP. The material presented in the book is primarily written for those who are already familiar with DSP concepts and are interested in designing DSP systems based on TI data converters and TI C6x DSP products. Note that a great deal of the information in this book appears in the TI reference manuals on the C6000 DSP family. However, this information has been restructured, condensed and modified to be used for teaching a DSP laboratory course in a semester period. It is

recommended that these manuals are used in conjunction with this book to fully make use of the information presented.

A data converter Matlab toolbox and eight lab exercises are discussed and included on an attached CD to take the reader through the entire process of analog to digital signal conversion and C6x code writing. As a result, the book can be used as a self-study guide for designing C6x-based DSP systems. The chapters are organized to create a close correlation between the topics and lab exercises if they are used as lecture materials for a DSP lab course. Knowledge of the C programming language and Matlab is required for understanding and performing the lab exercises.

Contents

Chapter 1 provides an overview of DSP systems. Chapters 2, 3, and 4 are dedicated to data convertion in DSP systems. Chapter 2 gives a discussion of the differences and relationships between analog and digital signals. This chapter includes a Matlab toolbox that can be used to acquire a hands-on exposure to the issues related to A/D and D/A data conversion. Chapter 3 discusses various specifications of data converters. It provides the information needed for selecting data converters in various applications of interest. The architectures of A/D and D/A converters are then presented in Chapter 4.

The DSP part of the book starts in Chapter 5 where an overview of the TMS320C6x architecture is presented. The focus here is placed on the architectural features one needs to be aware of for implementing algorithms on the C6x processor. In Chapter 6, the software tools are presented, and the steps in taking a source file to an executable file are discussed. Lab 1 in this chapter provides a hands-on approach to become familiar with the Code Composer Studio integrated development environment. Chapter 7 presents the process of interrupt data processing. Lab 2 in this chapter shows how to sample an analog signal in real-time on a C6x target board. In Chapter 8, fixed-point and floating-point number representations are discussed and their differences are pointed out. Lab 3 in this chapter shows how one may cope with the overflow or scaling problem. Code

efficiency issues appear in Chapter 9, where optimization techniques as well as linear assembly and hand-coded pipelined assembly are discussed. Lab 4 in this chapter covers FIR (finite impulse response) filtering while deploying different optimization techniques. Chapter 10 covers circular buffering. Lab 5 in this chapter shows how circular buffering is used to perform adaptive filtering. Frame processing is covered in Chapter 11. Lab 6 in this chapter provides an example of frame processing involving FFT (fast Fourier transform) implementation and the use of DMA (Direct Memory Access). Finally, Chapter 12 and Labs 7&8 address the DSP/BIOS real-time analysis and scheduling features of Code Composer Studio.