

Training workshop:

Course Title: DSP Practice Using TMS320C55x

Course Contents

Introduction to Digital Signal Processing:

- Basic DSP Algorithms

Introduction to Digital Signal Processors:

- Evolution of DSP Processors
- General purpose Microprocessors and DS Processors

Basic Architectural Features of DS Processors

- DSP's Computational Blocks
- Bus architecture and Memory
- Data Addressing Capabilities
- Address Generation Unit
- Speed Issues

TI's TMS320 Processors and their Features

Details of TMS320C55x

Software Development Tools for C55x: Code Composer Studio (CCS)

Developing a Simple Program

- Create/Open a new project
- Adding the required files to the project
- Build, Load Program and Run the project
- Execution: Run, Halt, Step into, Step over etc

Debugging a project using CCS

- Add/remove Breakpoint
- Viewing variables and changing their values by using watch window
- View Memory and CPU Registers
- View Disassembly
- Viewing the Call Stack

Additional features of CCS

- Adding a probe point for File I/O
- Displaying Graphs
- Creating a Library Project
- Profiling the program

Data Formats and Computational Accuracy in DSP Implementations

- Signed two's complement integer representation of data
- Fixed Point and Floating Point data formats

Fixed Point Arithmetic

- Fixed Point Addition (Numbers with same Q format)
- Fixed Point Subtraction (Numbers with same Q format)
- Fixed Point Addition (Numbers with same different format)
- Fixed Point Multiplication (Numbers with same Q format)
- Q Values in the Watch Window of CCS.

Fixed Point and Floating Point Processors

Dynamic Range and Precision

Quantization Errors

- Input Quantization Noise
- Coefficient Quantization Noise
- Round Off Noise

Overflow and Solutions

- Saturation and Arithmetic
- Overflow Handling
- Scaling of Signals

DSP Algorithms and their Fixed Point C Implementation

- Fixed Point C Coding and Issues
- To determine the impulse response of a system
- To implement difference Equations
- Convolution & Correlation
- DFT & FFT
- Decimation and Interpolation
- IIR and FIR Filters: Design (Using MATLAB and Fixed C implementation).

TMS320C55x Architecture

- TMS320C55x CPU
 - Memory Interface Unit
 - Instruction Buffer Unit (I Unit)
 - Instruction Buffer Queue
 - Instruction Decoder
 - Program Flow Unit (P Unit)
 - Program-Address Generation and Program-Control Logic
 - P-Unit Registers
 - Address-Data Flow Unit (A Unit)
 - Data Address Generation Unit
 - A-Unit Arithmetic Logic Unit
 - A-Unit Registers

- Data Computation Unit (D Unit)
 - Shifter
 - D-Unit Arithmetic Logic Unit
 - Two Multiply and Accumulate Units
 - D-Unit Registers
- TMS320C55x Buses
- TMS320C55x Buses
- TMS320C55x Memory Map

TMS320C55x Addressing Modes

- Direct Addressing Mode
- Indirect Addressing Mode
- Absolute Addressing Mode
- Memory-Mapped Register Addressing Mode
- Register Bits Addressing Mode
- Circular Addressing Mode

TMS320C55x Pipeline and Parallelism

- TMS320C55x Pipeline Phases
- Parallel Execution
- Pipeline Protection

TMS320C55x Instruction Set

- Arithmetic Instructions
- Logic and Bits Manipulation Instructions
- Move Instructions
- Program Flow Control Instructions

CPU Registers

- Memory Registers
- Accumulators
- Transition Registers
- Temporary Registers
- Registers used to Address Data Space and I/O Space
- Program Flow Registers
- Registers for Managing Interrupts
- Registers for Controlling Repeat Loops
- Status Registers

Stack Operation

Interrupts and Reset Operations

Mixed C and Assembly Language Programming (Interfacing C with assembly code)

Using *TMS320C55x DSP Library*

Lab Experiments

- Quantization of sinusoidal and speech signals
- Overflow and saturation arithmetic
- Quantization of coefficients
- Synthesizing Sine Functions
- Twiddle factor Generation
- Complex Data Operation
- Implementation of DFT
- Experiment using Assembly Routines
- Implementation of Block FIR filter
- Implementation of Symmetric FIR filter
- Implementation of FIR filter using Dual-MAC
- Implementation of IIR filter using floating-point C, fixed-point C using intrinsic functions and ASM programming.
- Radix-2 Complex FFT (using C program)
- Radix-2 Complex FFT using Assembly Language
- FFT and IFFT
- Fast Convolution

Real Time DSP implementation using C5515 eZdsp USB Stick

- Interfacing with the on-board Audio Codec
- Interfacing with the on-board LED
- Interfacing with the on-board dip switches
- Interfacing with the on-board NOR flash
- Interfacing with the on-board SD card
- I2S interface between C5515 DSP processor and Audio Codec
- Waveform Generation
- Multitone Generation and FIR Filtering
- Audio Effects
 - Echo and Reverberation
 - Upsampling and Down Sampling
 - Flanging
- Audio Filtering with FIR filters (Equalizers)
- Acoustic Echo Cancellation

Duration: 3 days