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Practical

# DIGITAL SIGNAL PROCESSING

for Engineers & Technicians



## THIS WORKSHOP WILL OFFER YOU:

- A clear understanding of digital signal processing (DSP)
- Benefits and application of DSP technology to improve efficiency
- Frequency analysis of signals and the application of this knowledge
- Information about and actual design of digital filters
- Analysis of the performance of DSP systems
- Identification of the key issues in designing a DSP system
- An understanding of the features and capabilities of commercial DSP applications

## WHO SHOULD ATTEND:

- Communications System Engineers
- Electrical and Electronic Engineers
- Control System Engineers
- Instrumentation Engineers
- Electrical and Electronic Technicians
- Design Engineers
- Condition Monitoring Engineers and Technicians



*Technology Training that Works*

## THE WORKSHOP

Digital Signal Processing (DSP) is the capture, analysis and manipulation of an analogue signal by a digital computer. The integration of DSP software and hardware into products across a wide range of industries has necessitated the understanding and application of DSP by engineers and technicians.

## WORKSHOP OBJECTIVES

The introduction of DSP from a practical point of view using a minimum of mathematics. The emphasis is on the practical aspects of DSP, implementation issues, tips, tricks and pitfalls, and practical applications. Intuitive explanations and appropriate examples are used to develop a fundamental understanding of DSP theory. The workshop participants will gain a clear understanding of DSP technology in a variety of fields from process control to communications.

### Some of the DSP techniques included in the workshop:

- digital filtering for cleaning a signal from noise
- discrete Fourier Transforms for finding a particular frequency component
- correlation techniques to find a signal buried in noise
- industrial control with digital controllers
- instrumentation and test for better accuracy
- vibration analysis for identifying frequency signatures
- image and video processing for enhancing images
- communications especially for filtering out noise

## PRACTICAL SESSIONS

There are eight practical sessions designed to enhance the delegate's understanding of the workshop. Most are software-based and make use of the widely used MATLAB software from Mathworks, Inc. Other sessions use the Texas Instrument DSP boards for experimentation.

- Introduction to MATLAB/SIMULINK and Signal Processing Toolbox
- Introduction to SIMULINK
- FIR Filter Design
- IIR Filter Design
- Filter Realisation
- Image Processing
- Sampling and Quantisation
- DSP Implementation

## THE PROGRAM

### DAY ONE

#### INTRODUCTION

- Terminology and motivation
- Why process digitally
- A typical DSP system
- Some current application areas

#### DIGITAL-TO-ANALOG AND ANALOG-TO-DIGITAL CONVERSION

- Periodic sampling and aliasing
- Digital to analog converters
- Analog reconstruction
- Analog to digital converters

#### DISCRETE SIGNALS AND SYSTEMS

- Discrete-time signals: notation and representation
- Classification of discrete systems
- The concept of impulse response
- The concept of convolution
- Autocorrelation and cross-correlation of signals
- *Practical Session*

#### FREQUENCY ANALYSIS OF DISCRETE SIGNALS

- Fourier series for periodic signals
- Discrete Fourier Transform (DFT) for non-periodic signals
- Understanding the DFT equation
- DFT properties
- The Inverse DFT
- The Fast Fourier Transform (FFT)
- Frequency analysis of discrete signals: use of windows and DFT results interpretation
- Fast computation of convolution using DFT
- Other related transforms
- *Practical Session*

#### DSP APPLICATION EXAMPLES

- Digital waveform generators
- Speech modelling and synthesis
- Noise reduction and signal enhancement
- Image restoration
- Communications system
- *Practical Session*

### DAY TWO

#### IIR DIGITAL FILTER DESIGN

- Review of classical filter approximation techniques
- Characteristics of IIR filters
- Design methods
- Design examples
- *Practical Session*

#### FIR DIGITAL FILTER DESIGN

- Characteristics of FIR filters
- Design methods
- Design examples
- *Practical Session*

#### DIGITAL FILTER REALISATIONS

- Direct form
- Hardware realisations
- Quantisation effects
- *Practical Session*

#### COMMERCIAL DSP HARDWARE

- Architectural difference between DSP chips and general purpose microprocessors
- Texas Instrument TMS320 family
- Motorola DSP56000 family
- Analog Devices ADSP-2100 family
- Choosing a DSP architecture
- DSP trends
- *Practical Session*

#### PRACTICAL TOOLS FOR DSP SYSTEM DEVELOPMENT

- Simulation tools for algorithm development
- Software development tools
- Hardware development tools
- *Practical Session*

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*Instructor has excellent knowledge on the subject.*

A. J. Pretorius

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