

DIGITAL SIGNAL PROCESSING

INTRODUCTION

1. Types of Signals
2. Digital vs Analog Signal Processing
3. Applications
4. Basic block diagram
5. DSP History

TYPES OF SIGNALS

A signal is a function that contains information which can be transmitted, displayed, or manipulated. Particular examples of signals include

1. speech (digital answering machines, voice synthesis and recognition)
2. music (CD technology, digital radio)
3. biomedical signals (eeg, ecg)
4. image (JPEG standard, digital camera)
5. video (MPEG standard, digital TV)
6. radar signals (to determine range and direction to distant targets)

DIGITAL VS ANALOG SIGNAL PROCESSING

Advantages:

1. guaranteed accuracy
2. perfect reproducibility
3. robust to temperature and age
4. great flexibility (programmable)
5. new algorithms become possible (adaptive filtering)

Disadvantages:

1. speed (≈ 100 MHz max bandwidth)
2. cost (high speed require expensive ADC/DACs)
3. design time
4. finite precision problems
5. power consumption

APPLICATIONS

1. Communications

- (a) Multiplexing
- (b) Echo reduction
- (c) Noise reduction
- (d) Channel equalization
- (e) Audio/image/video compression

2. Medicine

- (a) Diagnostic tests
- (b) Monitoring patient biosignals
- (c) Medical image enhancement/compression

3. Science

- (a) Remote sensing
- (b) Spectral analysis
- (c) System identification
- (d) Seismic data analysis

4. Manufacturing

- (a) Oil exploration
- (b) Nondestructive testing
- (c) Process monitoring and quality control

5. Military

- (a) Radar
- (b) Sonar
- (c) Secure communication

6. Entertainment

- (a) Digital audio
- (b) Special effects
- (c) Electronic music synthesis

7. Education

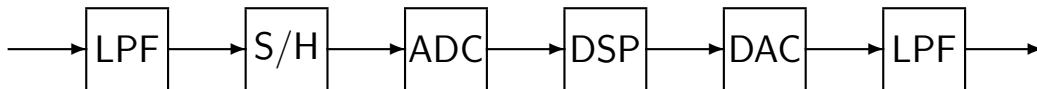
- (a) Educational toys (Speak and Spell)
- (b) Multimedia software

8. Speech processing

- (a) Speech synthesis
- (b) Speech recognition
- (c) Speech compression
- (d) Speech enhancement
- (e) Text to speech

BASIC BLOCK DIAGRAM

- LPF: Lowpass filter
- S/H: Sample/Hold circuit
- ADC: Analog to Digital Converter
- DSP: Digital Signal Processor
- DAC: Digital to Analog Converter



DSP HISTORY

The book, “Signal Processing: The Emergence of a Discipline” by Frederik Nebeker gives a careful history of the development of signal processing.

1. In the early days, it was not thought that one would use digital computers to processing signals, but that one would use them to *simulate* analog systems.
2. Speech processing and seismic analysis (for oil exploration) were an early application of DSP.