

APPLICATIONS OF DSP

DSP is Everywhere

- **Sound applications**

- Compression, enhancement, special effects, synthesis, recognition, echo cancellation,...
- Cell Phones, MP3 Players, Movies, Dictation, Text-to-speech,...

- **Communication**

- Modulation, coding, detection, equalization, echo cancellation,...
- Cell Phones, dial-up modem, DSL modem, Satellite Receiver,...

- **Automotive**

- ABS, GPS, Active Noise Cancellation, Cruise Control, Parking,...

- Medical**

Magnetic Resonance, Tomography, Electrocardiogram,...

- Military**

Radar, Sonar, Space photographs, remote sensing,...

- Image and Video Applications**

DVD, JPEG, Movie special effects, video conferencing,...

- Mechanical**

Motor control, process control, oil and mineral prospecting,...

Signal Processing

- Humans are the most advanced signal processors
 - speech and pattern recognition, speech synthesis,...
- We encounter many types of signals in various applications
 - Electrical signals: voltage, current, magnetic and electric fields,...
 - Mechanical signals: velocity, force, displacement,...
 - Acoustic signals: sound, vibration,...
 - Other signals: pressure, temperature,...

Signal Processing (contd...)

- Most real-world signals are analog they are continuous in time and amplitude Convert to voltage or currents using sensors and transducers
- Analog circuits process these signals using Resistors, Capacitors, Inductors, Amplifiers,...
- Analog signal processing examples Audio processing in FM radios Video processing in traditional TV sets

Limitations of Analog Signal Processing

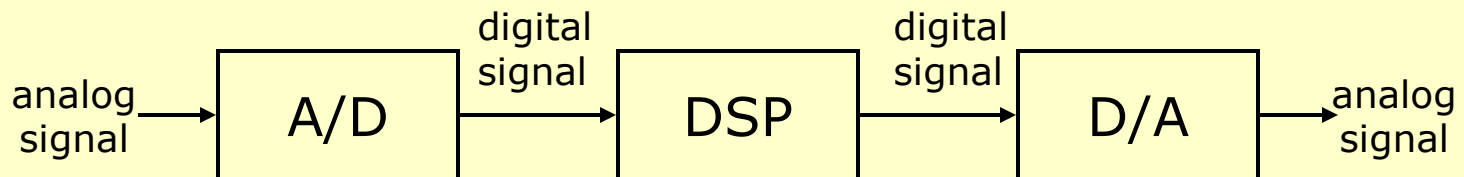
- Accuracy limitations due to
 - Component tolerances
 - Undesired nonlinearities
- Limited repeatability due to
 - Tolerances
 - Changes in environmental conditions
 - Temperature
 - Vibration

Limitations (contd..)

- Sensitivity to electrical noise
- Limited dynamic range for voltage and currents
- Inflexibility to changes
- Difficulty of implementing certain operations
 - Nonlinear operations
 - Time-varying operations
- Difficulty of storing information

Digital Signal Processing

- Represent signals by a sequence of numbers
 - Sampling or analog-to-digital conversions
- Perform processing on these numbers with a digital processor
 - Digital signal processing
- Reconstruct analog signal from processed numbers
 - Reconstruction or digital-to-analog conversion



- Analog input – analog output
 - Digital recording of music
- Analog input – digital output
 - Touch tone phone dialing
- Digital input – analog output
 - Text to speech
- Digital input – digital output
 - Compression of a file on computer

Pros and Cons of Digital Signal Processing

- **Pros**

- **Accuracy can be controlled by choosing word length**
- **Repeatable**
- **Sensitivity to electrical noise is minimal**
- **Dynamic range can be controlled using floating point numbers**
- **Flexibility can be achieved with software implementations**
- **Non-linear and time-varying operations are easier to implement**
- **Digital storage is cheap**
- **Digital information can be encrypted for security**
- **Price/performance and reduced time-to-market**

- **Cons**

- **Sampling causes loss of information**
- **A/D and D/A requires mixed-signal hardware**
- **Limited speed of processors**
- **Quantization and round-off errors**