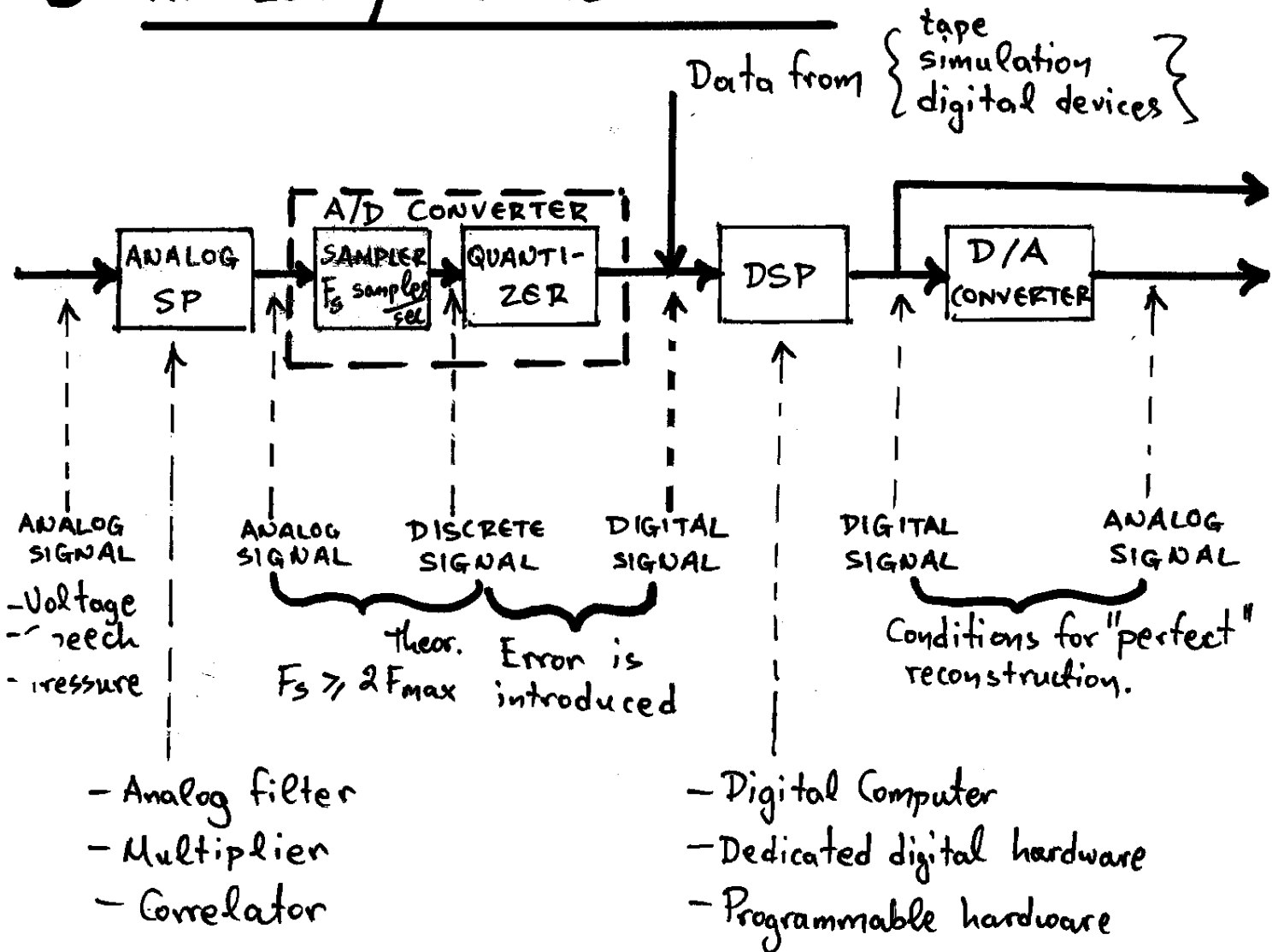


ANALOG / DIGITAL SYSTEM



PURPOSE : To process signals by digital means

NOTE : While most "real world" signals are analog and most signals processed by computer are digital, in this course we will deal almost exclusively with discrete time signals (assuming no errors are introduced from quantization) to make our results mathematically tractable. In reality though, everything is done digitally

ANALOG VERSUS DIGITAL (DISCRETE) S.P. (2)

1. DSP implementations are more flexible, programmable and precise than ASP implementations. They feature higher repeatability and modularity.
2. Performance and cost effectiveness of DSP implementations are enhanced by microelectronics and other technologies to a higher degree than ASP implementations.
3. Mathematical expressions can be implemented directly and with little approximation with DSP while ASP does not allow this. Therefore, far more sophisticated algorithms can be implemented with DSP.
4. Digital hardware can be multiplexed far better than analog hardware. → Integration of operations and services.
5. Digital information can be easily stored.

NOTE: Analog SP is ^{presently} more suitable in applications that require very high bandwidths, very high dynamic ranges, very low power.

"HOT" APPLICATIONS IN DSP

(3)

- ENTERTAINMENT: Digital Audio, TV, Multimedia
- Medical Imaging, medical data analysis
- Information services, databases
- Personal Communications
- Metrology
- Nondestructive testing of materials
- manufacturing processes / digital process control
- Automotive electronics
- Sensor (and other) data transmission, storage, reconstruction, voice and image synthesis
- System identification, equalization
- Digital representations for editing, composition
- Remote education (HDTV)
- Environmental monitoring
- Voice mail.

(4)

Topics Covered Will Include:

Review of discrete signals and systems
 Sampling of continuous time signals
 Multirate systems
 The Discrete Fourier Transform (DFT)
 Fast Fourier Transforms (FFT)
 Brief review of the Z-transform
 Nonrecursive (FIR) and recursive (IIR) systems
 Digital filter design
 Quantization and Round-off noise effects
 1-D and 2-D Digital Signal Processing
 Applications to communications, spectral analysis and multimedia

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FACTS & CHALLENGES

- One frame of uncompressed video ~ 1 Mbyte
- One second of full motion video ~ 30 Mbytes
- A CD ~ 650 Mbytes (20 sec. of Full motion video)
- A DVD ~ 4.7 Gbytes (3 minutes of full motion video)
- Current DVD technology (MPEG): compression 100:1
- Div X technology: // 1000:1
 (makes possible to store an entire movie on a single CD or DVD or send over internet)
- ADC $\sim$ values of 100-200 MSPS at 16 bit resolt.
 values of (order) GSPS at 8 bit //
- Basic DSP operations require 100 operations/sample
 or $\sim 10,000$ Moperations / sec