

What is digital signal processing?

Basic DSP system:



Advantages:

- DSP hardware is flexible and programmable
- DSP chips are relatively cheap (easily mass-produced)
- Digital storage is cheap
- Digital information can be encrypted, coded, and compressed

Disadvantages:

Consider:

“That discipline which has allowed us to replace a circuit previously composed of a capacitor and a resistor with two antialiasing filters, an A-to-D and D-to-A converter, and a general purpose computer (or array processor) so long as the signal we are interested in does not vary too quickly.”

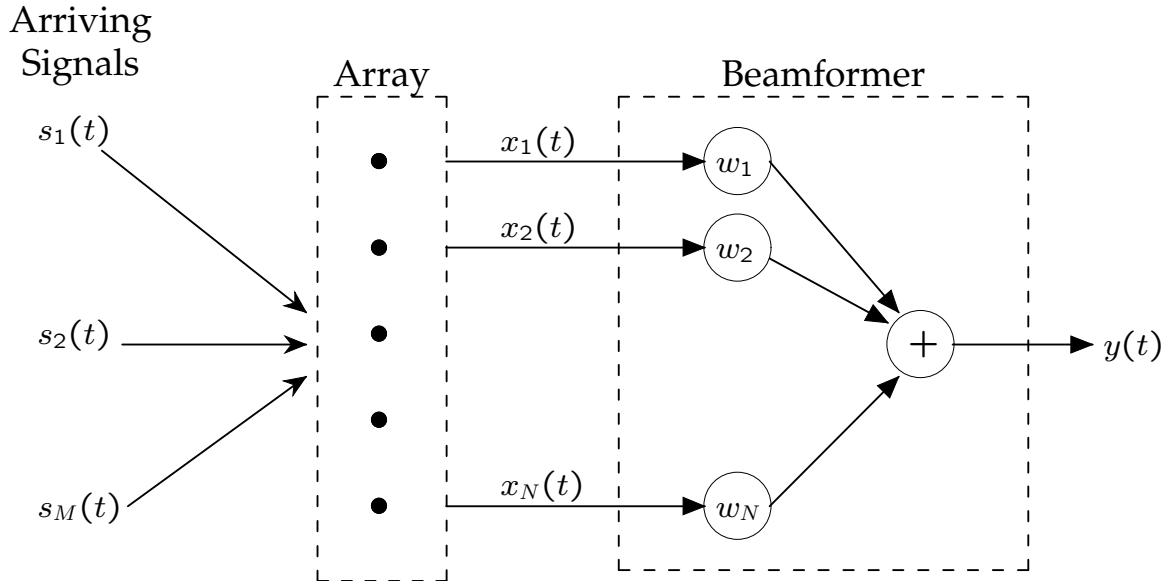
–Thomas P. Barnwell, 1974 (Source: A Course in DSP, Boaz Porat, 1997)

- Sampling leads to loss of information
- High-resolution ultra-fast A/D and D/A may be expensive
- Digital processing cannot always be done in real-time

Applications of DSP

- Digital Audio and Video
 - compact discs
 - Dolby recording
 - HDTV
 - JPEG, MPEG
- Speech systems
 - recognition
 - synthesis
- Industrial
 - noise cancellation
 - manufacturing control
- Biomedical
 - ultrasound
 - hearing aids
- Telecommunications
 - wireless phones
 - DSL, cable modems
- Science
 - speech pathology
 - gene research
- Sonar and radar
 - surveillance and guidance systems
 - oceanography

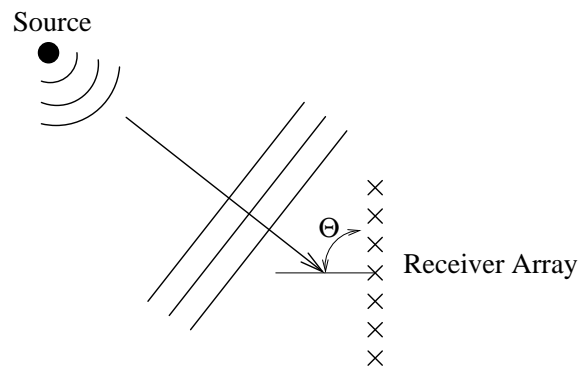
Array processing (beamforming) problem



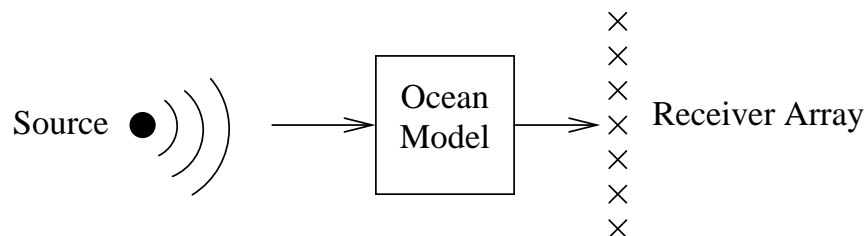
Processing enhances signal and suppresses noise/interference

- Signal models

- planewave → beamforming



- physics-based → matched field processing



DSP is a multi-billion dollar business

DSP is a major driver for the semiconductor industry

DSP chip market was 11.1 billion worldwide in 1999
(11.1 billion for hardware only!)

- 1.0% DSP building blocks
- 2.9% media processors
- 39.5% programmable DSP's
- 56.6% function-specific DSP's

Examples of function-specific DSP chips:

- AM/FM radio decoders
- Answering machine chips
- Cable modem chips
- Digital camera chips
- Digital hearing aids
- DVD decoders
- Hard disk read channels
- MP3 player chips
- Voice over IP chips

Source: "Digital Signal Processing: The New Semiconductor Industry Technology Driver," Will Strauss, IEEE Signal Processing Magazine, March 2000, pp. 52-56.

Foundations of DSP

What do you have to know to start working on DSP?

- Fluent in mathematics
- Thorough understanding of sampling and its consequences
- Knowledge and appreciation of signal transforms
- Basic spectral analysis tools: DFT/FFT
- Ability to implement simulations in software such as Matlab
- Understanding of the science, mathematics, and/or engineering behind a particular application

What will ECE 535 cover? \Rightarrow

ECE 535

- Syllabus
 - Review of DT signals & systems
 - DT processing of CT signals
 - Discrete Fourier series & discrete Fourier transform
 - Filter design
 - Implementation issues
 - Advanced topics: beamforming, MPEG coding
- Course information sheet
 - Website
 - Required textbooks
 - Required software
 - Grading
 - Policies
 - Lectures
 - Office hours
- Makeup classes
- Questions?