《数字信号处理》：导论

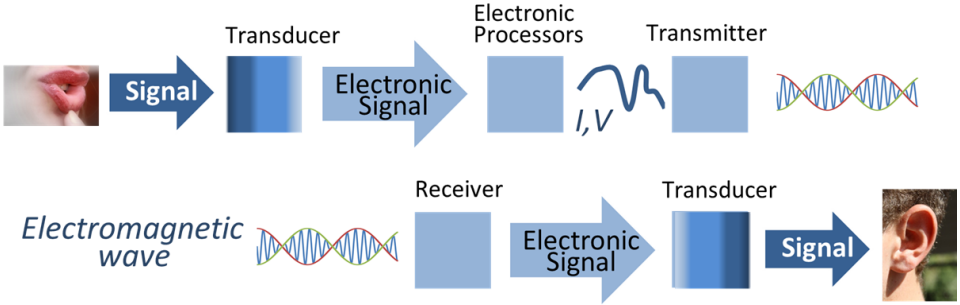
Digital Signal Processing: Introduction

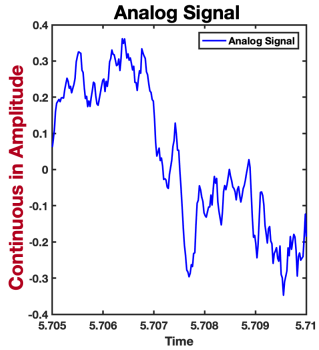
Introduction to Digital Signal Processing

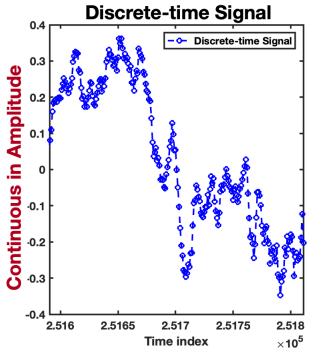
DSP MOOC Course

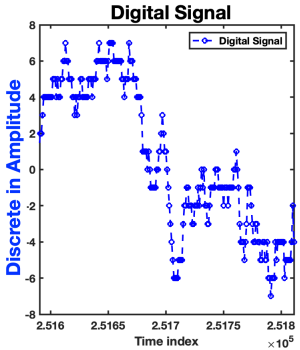
What is Signal?

Signals: functions conveying *information about the behavior or attributes of some phenomenon*.


Transducer
Electronic Processors
Transmitter
Signal
Electronic Signal
I,V
Receiver
Transducer
Electromagnetic wave
Electronic Signal
Signal



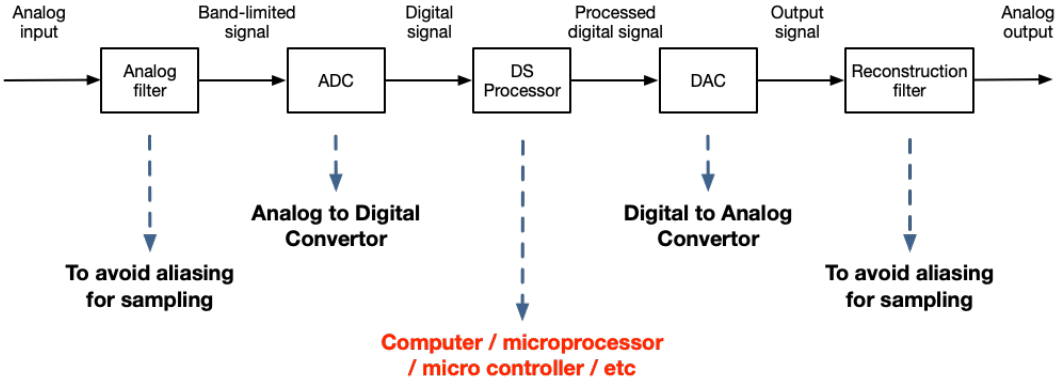




Continuous in time

Discrete in time

Discrete in time


Analog input
Analog filter
Band-limited signal
ADC
Digital signal
DS Processor
Processed digital signal
DAC
Output signal
Reconstruction filter
Analog output
To avoid aliasing for sampling
Analog to Digital Convertor
Computer / microprocessor / micro controller / etc
Digital to Analog Convertor
To avoid aliasing for sampling

Digital signal processing is

- **easier for storage**
- **more reliable and flexible**
- **stronger immunity to noise**
- ...

than directly processing Analog signals.

But Digital is less accurate, harder to implement ultra-high frequencies, more power consumption ...

Evolution of the Mobile Phone
Motorola 8900X-2
Nokia 2146
Nokia 3210
Nokia 6210
Ericsson T39
Alcatel OT511
Samsung E250
Apple iPhone
BlackBerry Curve 8900
Samsung Galaxy S2
Samsung Galaxy S4
Sony Xperia Z Ultra

Evolution of Memory Storage

Evolution of TV

1930s

1940s

1950s

1960s

1970s

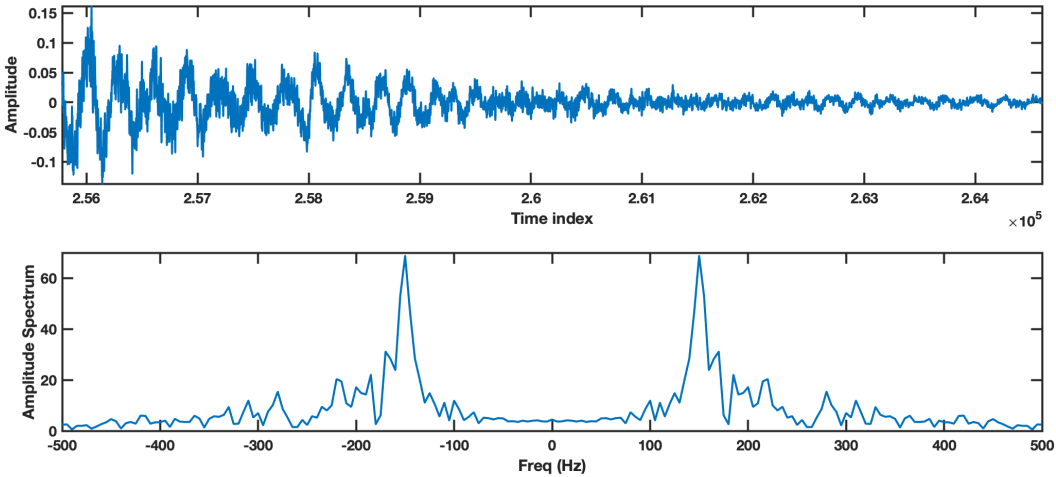
1980s

1990s

2000s

2010s

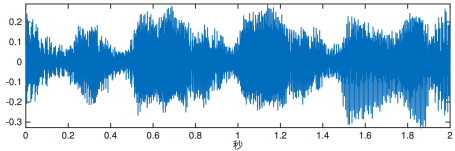
Signal spectral analysis:

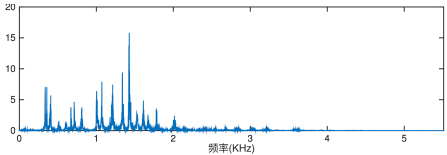


Noise removal for speech:

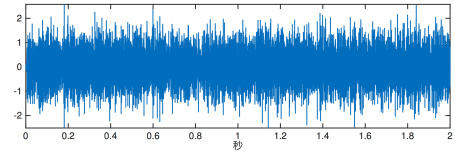
Music in Time-domain | **Freq.-domain**

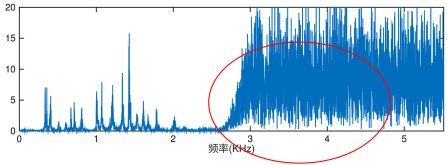
Org.



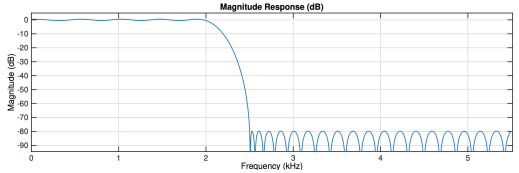


Noisy

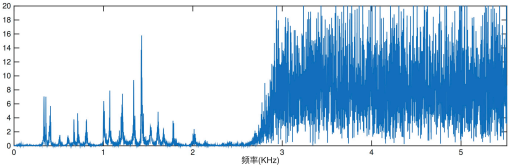




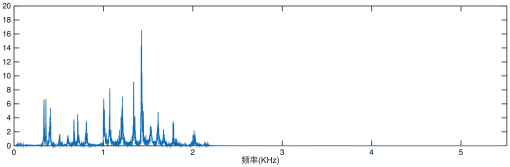
Amp. Resp.



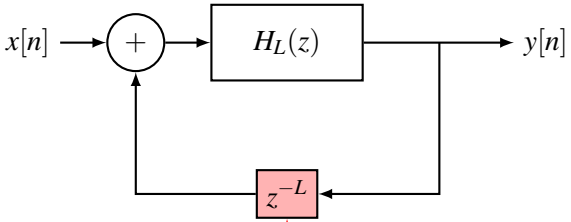
before filtering



after filtering

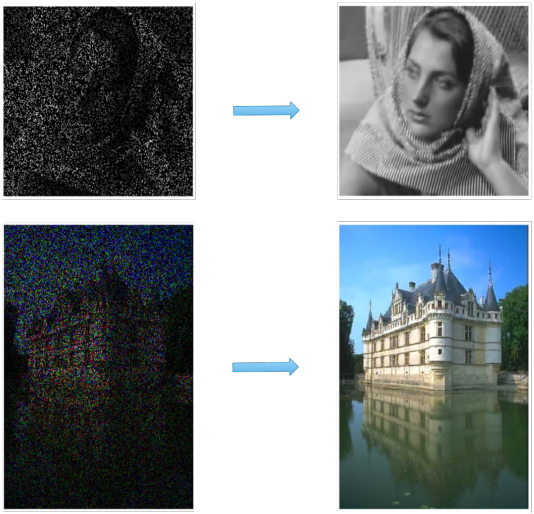


Music synthesis by Karplus-Strong:



[1] http://legacy.spa.aalto.fi/demos/tunable-disp/
[2] http://theneuralbit.com/comfortably-numb-synth.html
[3] http://www.music.mcgill.ca/ gary/courses/papers/Jaffe-Extensions-CMJ-1983.pdf

Image Restoration:



What will be learnt from DSP?

- **Bridge from A to D:**
  - Sampling
  - Quantification
- **DSP in Time-Domain:**
  - Convolution / Correlation
  - Filters / Filter Design
- **DSP in Frequency-Domain:**
  - DTFT / DFT / FFT
  - ZT
  - Filter Design