Digital signal processing

The fundamental concepts

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## 1 signal

A graph of a graph

Description automatically generated

## 2 FFT and FFTshift

A diagram of a graph

Description automatically generated

Modify the frequency range

samples, sampling rate Fs=1000

Frequency range:

1st plot:

2nd Plot:

y(n)=ifft(fft(x))

## 3 Convolution

A diagram of a function

Description automatically generated

A mathematical equation with black symbols

Description automatically generated with medium confidence

* Discrete convolution

A diagram of a function

Description automatically generated

h=[1,0,0,0.5,0,-0.2,0,0.1]; % impulse response

n=0:200; x=2\*cos(0.1\*pi\*n); % input signal

y=conv(x,h); % output signal

plot(y)

A screenshot of a graph

Description automatically generated

## 4 Auto Correlation

For a signal with zero mean, to see if the samples are “correlated” with each other.

A math equations on a white background

Description automatically generated

A graph of a graph of a graph

Description automatically generated with medium confidence

## 5 Upsampling and downsampling

* Upsampling: including 2 steps:

i) Upsampling

ii) low-pass filter

* Downsampling

i) downsampling with scaling in the amplitude.

* Analysis in the frequency domain

i) Pay attention to the amplitude

ii) The periodic frequency after upsampling

iii) The amplitude after downsampling

A screenshot of a computer screen

Description automatically generated

Time domain

A screenshot of a graph

Description automatically generated

Frequency domain

## Reference

1. rectangularPulse, <https://www.mathworks.com/help/symbolic/sym.rectangularpulse.html#btke0hr-47>
2. Upsampling and downsampling, <https://www.geeksforgeeks.org/what-is-upsampling-in-matlab/>
3. Roberto Cristi, Wireless Communications with Matlab and Simulink: IEEE802.16 (WiMax) Physical Layer, <https://faculty.nps.edu/rcristi/WiMax/2009-08-20-WiMax.pdf>