EMPossible

Computational Science:
Computational Methods in Engineering

Calculating & Displaying Frequency Plots

Nyquist Sampling Theorem

If a signal is periodic with period τ, the maximum possible sampling period Δt that can still resolve the signal is

$$\Delta t \leq \frac{\tau}{2}$$

Similarly, if a signal has a maximum frequency of $f_{\max}$, the minimum sampling frequency f_{s} to resolve the signal is

$$f_{\mathrm{s}} \geq 2 f_{\max}$$

EMPossible

Slide 2

Frequency Limits

Given a discrete function $f(n)$ sampled at intervals of Δt:

(1) the maximum frequency $f_{\max}$ resolved by the FFT is determined by the sampling period Δt.

$$f_{\max} = \frac{0.5}{\Delta t}$$

(2) the frequency resolution Δf is determined by the number of samples N.

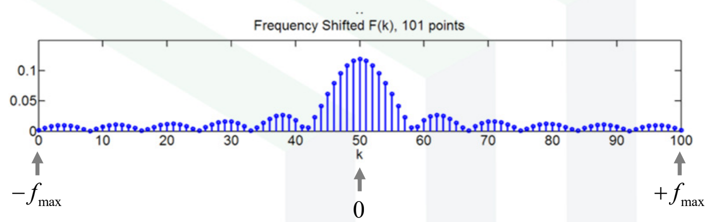
$$\Delta f = \frac{2 f_{\max}}{N} = \frac{1}{N \cdot \Delta t}$$

EMPossible

Slide 3

Frequency Axis (1 of 2)

The FFT calculates the complex amplitude of the frequencies over a range of frequencies from $-f_{\max}$ up to $+f_{\max}$.



Based on this, calculate the frequency axis `freq` according to

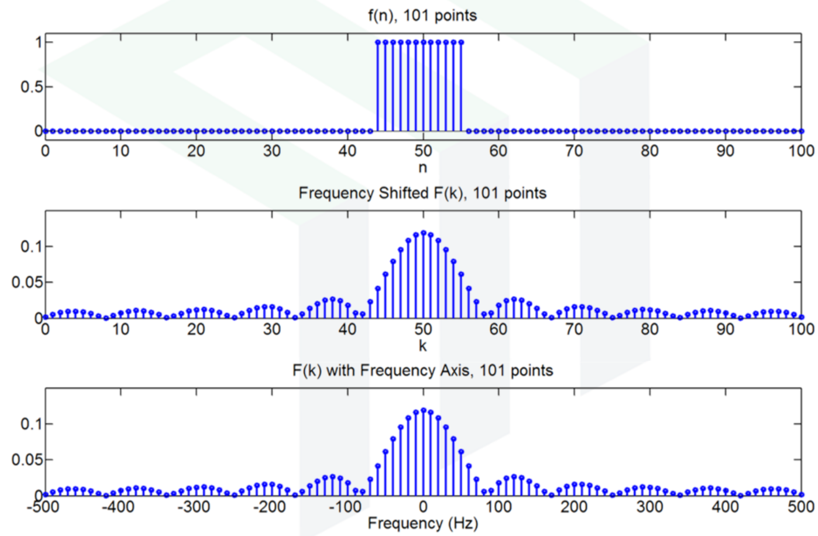
```
fmax = 0.5/dt;
df   = 1/(N*dt);
freq = linspace(-fmax,fmax,N);
```

Note: Make N odd!

EMPossible

Slide 4

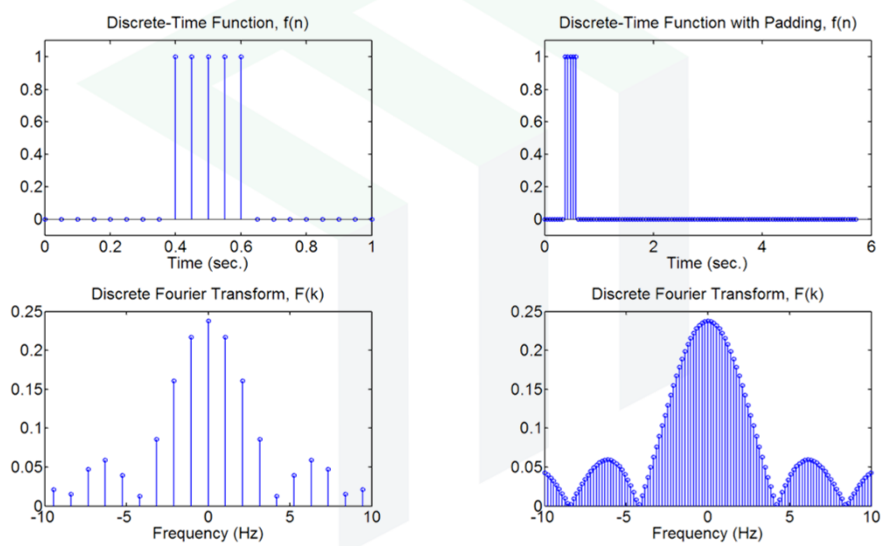
Frequency Axis (2 of 2)



EMPossible

Slide 5

Padding the FFT to Plot the DTFT



EMPossible

Slide 6