University Of Bourgogne

Digital Signal Processing

# Discrete Fourier Transform and Inverse (DFT)

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January 1, 2020

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## Discrete Fourier Transform:

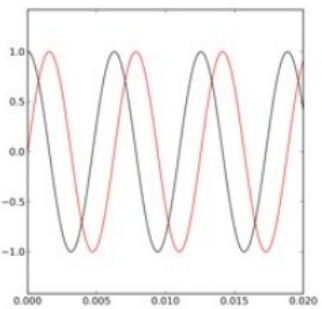
The discrete Fourier transform (DFT) converts a finite sequence of equally-spaced samples of a function into a same-length sequence of equally-spaced samples of the discrete-time Fourier transform (DTFT), which is a complex-valued function of frequency. The interval at which the DTFT is sampled is the reciprocal of the duration of the input sequence. An inverse DFT is a Fourier series, using the DTFT samples as coefficients of complex sinusoids at the corresponding DTFT frequencies. It has the same sample-values as the original input sequence.

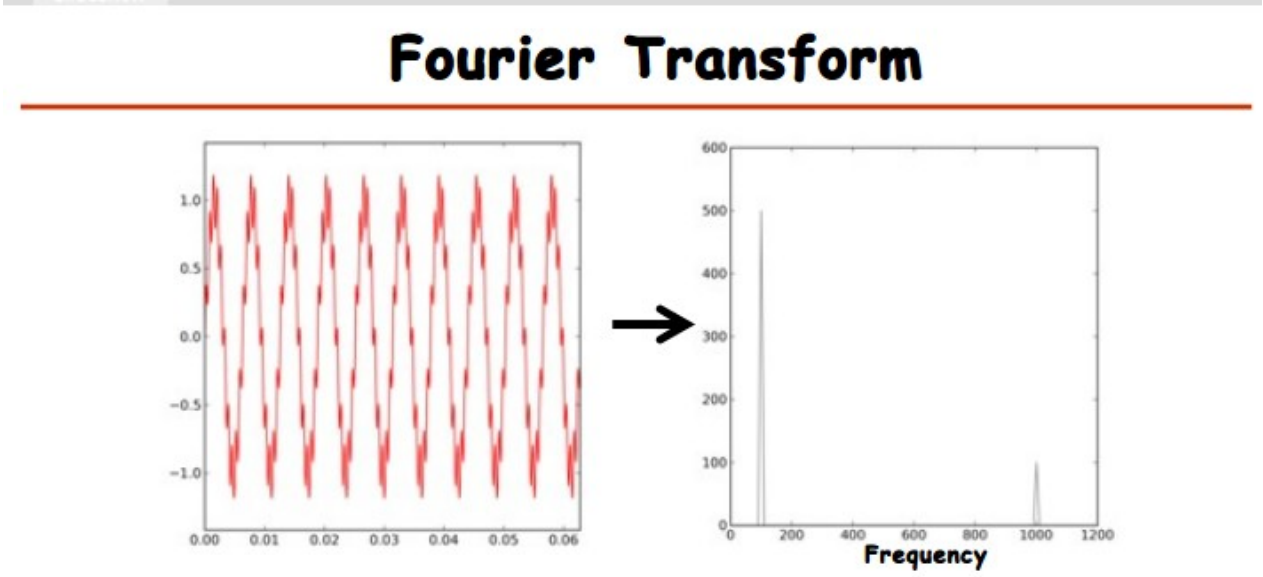
The DFT is therefore said to be a frequency domain representation of the original input sequence. If the original sequence spans all the non-zero values of a function, its DTFT is continuous (and periodic), and the DFT provides discrete samples of one cycle. If the original sequence is one cycle of a periodic function, the DFT provides all the non-zero values of one DTFT cycle.

**Fourier Transform**

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x)\, e^{-2\pi i x \xi}\,dx$$

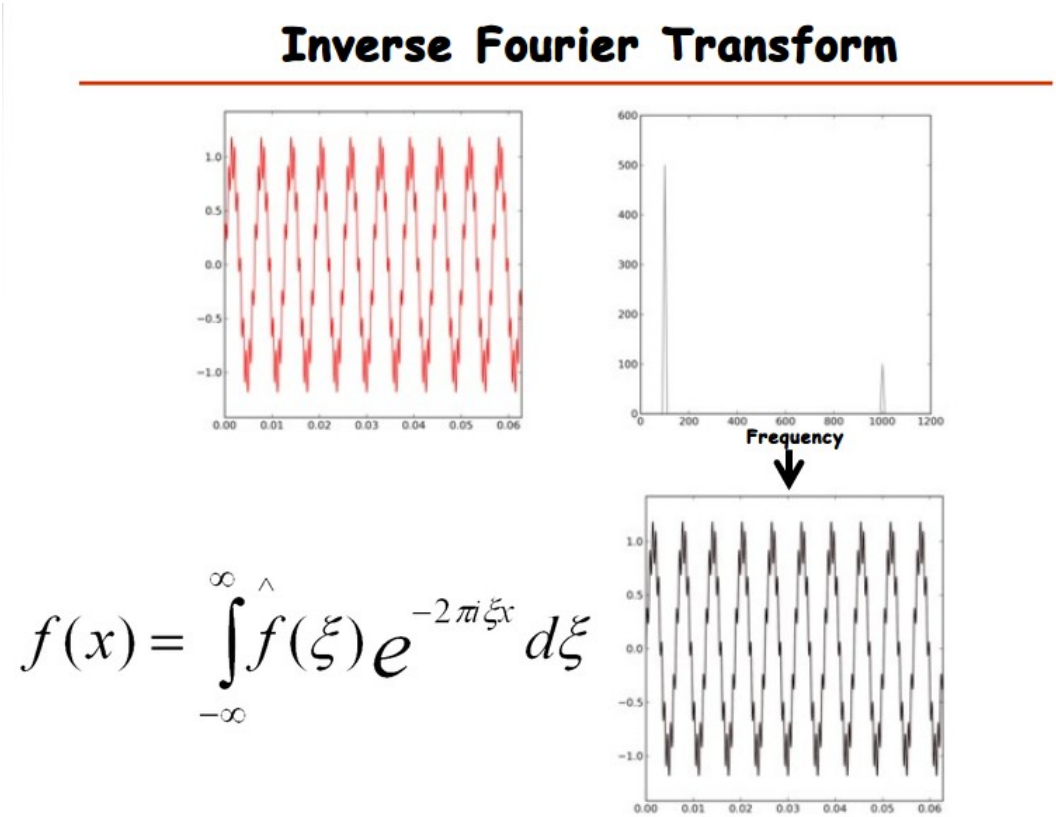
$$e^{2\pi i\theta} = \cos(2\pi i\theta) + i\sin(2\pi i\theta)$$






## Inverse Discrete Fourier Transform:

Maps the signal back from the frequency domain into the time domain.,takes the frequency series of complex values and maps them back into the original time series. Assuming that the original time series consisted of real values, the result of the IDFT will be complex numbers where the imaginary part is zero.



# DSP System (DFT and IDFT):

Add to The application the following features:

1. The ability to apply Fourier transform to any input signal then display frequency versus amplitude and frequency versus phase relations after asking the user to enter the sampling frequency in HZ.
2. The frequency components should be saved in txt file in polar form (amplitude and phase)
3. Calculate the time taken for the Fourier transform and display it in a message box.
4. The ability to read a txt file that contains frequency components in polar form and reconstructing the signal by IDFT.