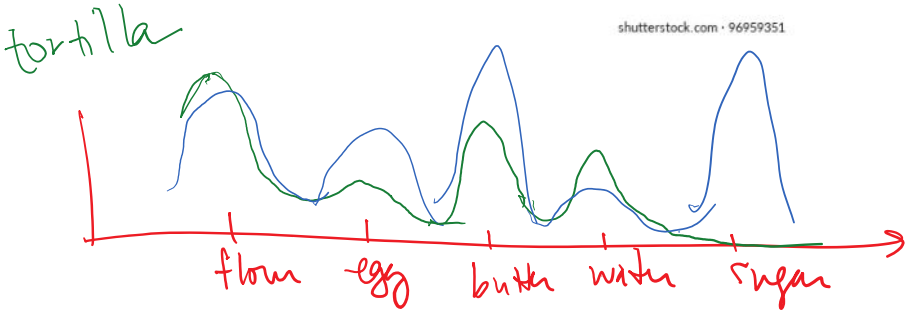
Basis function

Wednesday, February 23, 2022 10:00 AM



Basis functions

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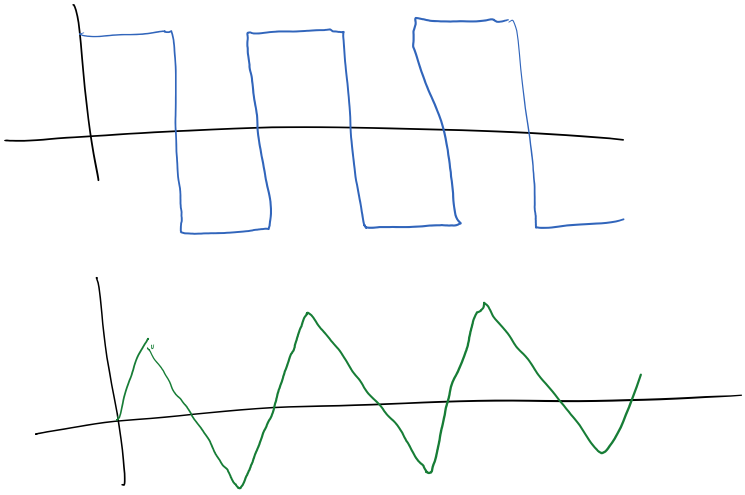
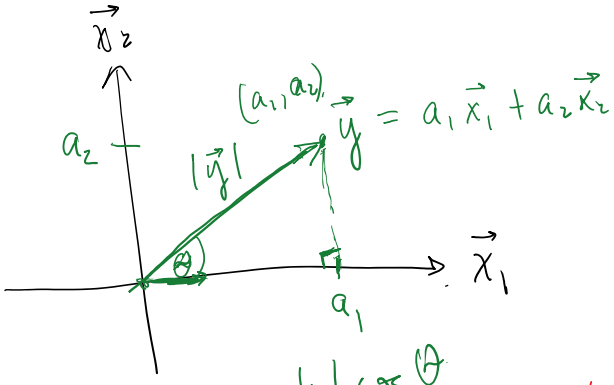
Components of a signal, that when weighted properly comprise the complete signal



$$x(t) = \int a_n f_n(t)\, dt$$

basis function
"proxy function"

$$a_n = x(t) \cdot f_n(t)$$



$$a_1 = |y| \cos\theta$$

$$a_1 = \vec{y} \cdot \vec{x}_1$$

$$= |\vec{y}|\,|\vec{x}| \cos\theta$$

1. b/c (unit vector).

Fourier series demo

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$$x[t] = \frac{a_0}{2} + \sum_m a_m \cos(2\pi m f_1 t) + \sum_m b_m \sin(2\pi^m f_1 t)$$

fundamental frequency

m^{th} harmonic.

$$a_m = \sum_{n=1}^{N} x[n] \cos(2\pi m f_1 n T_s)$$

$$b_m = \sum_{n=1}^{N} x[n] \sin(2\pi m f_1 n T_s)$$

$$x[t] = \sum_m c_m e^{j 2\pi m f_1 n T_s}$$

Fourier transform

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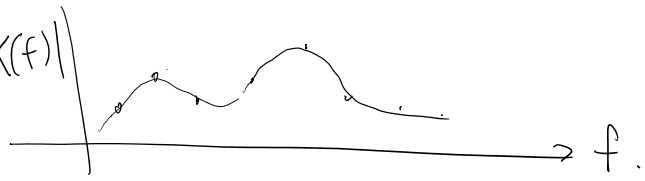
$$X[m] = \sum_{n=1}^{N} x[n] e^{-j 2\pi m n T_S} \quad m = -\frac{N}{2}, \cdots, -1, 0, 1, \cdots, \frac{N}{2}$$

$$= \sum_{n=1}^{N} x[n] \cos[2\pi m n / N] + j \sum_{n=1}^{N} x[n] \sin[2\pi m n / N]$$

Magnitude of $X(f)$: $|X(f)|$

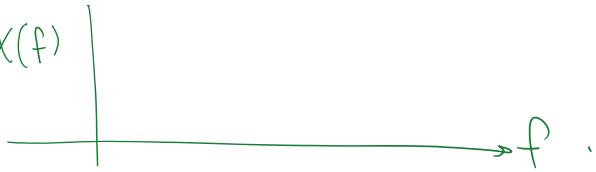


$X(f)$ = Spectrum of $x[n]$.

foiq

CT $X(f)$ spectrum of $x(t)$.

Phase of $X(f)$: $\angle X(f)$



Euler's formula

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$$e^{j\theta} = \cos\theta + j\sin\theta.$$

Complex number review

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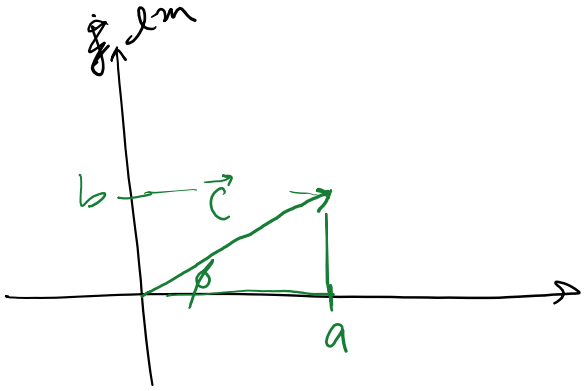

$\vec{C} = a + j \cdot b$.

$|\vec{C}| = \sqrt{a^2 + b^2}$

$\angle \vec{C} = \tan^{-1}\left(\frac{b}{a}\right)$

$\left(\tan \phi_1 = \frac{b}{a}\right)$

Continuous Time Fourier Transform

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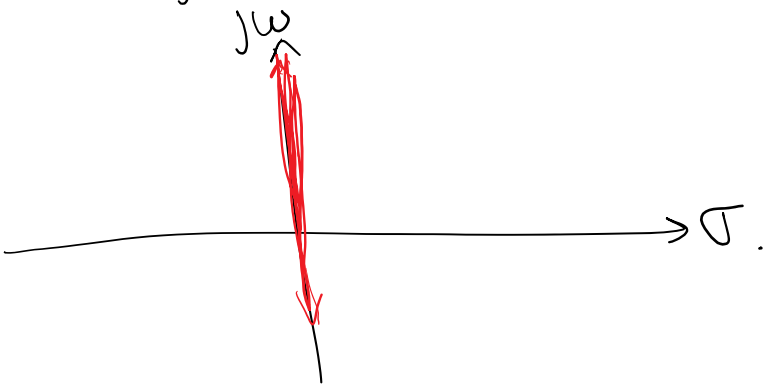
$$X(\omega) = \int x(t) \cdot e^{j\omega t} \, dt.$$ Fourier Transform of $x(t)$

$$X(s) = \int x(t) \cdot e^{st} \, dt.$$ Laplace Transform of $x(t)$

$s = \sigma + j\omega$



DTFT = discrete time Fourier transform

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~~Continuous Time Domain~~ → Discrete Time Domain.

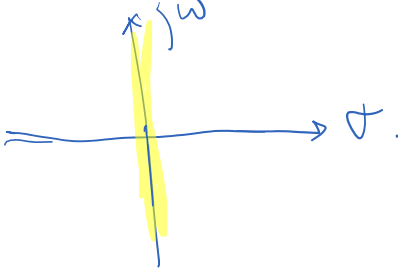
$$X(\omega) = \int_{-\infty}^{\infty} x(t) \cdot e^{j\omega t}\, dt.$$

$$\tilde{X}(\omega) = \sum_{n=-\infty}^{\infty} x[n]\, e^{-j\omega n} \qquad \text{D.T.F.T.}$$

$$X(s) = \int x(t) \cdot e^{-st}\, dt.$$

$$\tilde{X}(z) = \sum x[n]\, z^{-n} \qquad \text{"z transform"}$$

$s = \sigma + j\omega$



$z = R \cdot e^{j\omega}$