Forenoon Session :-

Date: 26th May
Course: Signals & System
Topic: Fourier series & Gibbs phenomena using python.
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Sem & Sec: IV Sem & 'A' Sec.

Report :-

$$(f*g) = \int_{-\infty}^{\infty} f(x-\xi)\, g(\xi)\, d\xi.$$

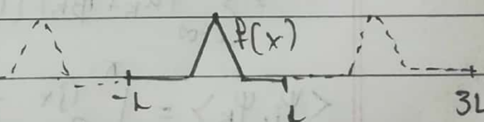
$$\left.\begin{aligned} \hat{f}(\omega) &= F(f(\omega)) = \int_{-\infty}^{\infty} f(x)\, e^{-i\omega x}\, dx. \\ f(x) &= F^{-1}(A\omega) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \hat{f}(\omega) \cdot e^{i\omega x}\, d\omega. \end{aligned}\right\} \text{Fourier transform pairs.}$$

$$F(f * g) = F(f)\, F(g) = \hat{f}\hat{g}$$

$$F^{-1}(\hat{f}\hat{g}) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \hat{f}(\omega)\, \hat{g}(\omega)\, e^{i\omega x} \cdot d\omega.$$

Data Driven :-

$$f(x) = \sum_{k=-\infty}^{\infty} C_k\, e^{ik\pi x/L} \qquad \omega_k = k\pi/L.$$



$$C_k = \frac{1}{2\pi}\langle f(x), \psi_k \rangle = \frac{1}{2L}\int_{-L}^{L} f(x)\, \underbrace{e^{-ik\pi x/L}}_{\psi_k}\, dx$$

$$f(x) = \lim_{\Delta\omega \to 0} \sum_{k=-\infty}^{\infty} \frac{\Delta\omega}{2\pi} \int_{-\pi/\Delta\omega}^{\pi/\Delta\omega} f(\xi)\, e^{-ik\Delta\omega\xi}\, d\xi \; e^{ik\Delta\omega x}$$

The Fourier transform Derivatives :-

$$F\left(\frac{d}{dx} f(x)\right) = \int_{-\infty}^{\infty} \underbrace{\frac{df}{dx}}_{dv}\, \underbrace{e^{-i\omega x}}_{u}\, dx$$

Fourier transform & Convolution :-

$$F(f*g) = F(f)\, F(g) = \hat{f}\hat{g}$$
$$= f * g.$$

Date: / /

Intuition of Fourier transform & Laplace Transform:-

$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t}\, dt, \quad e^{-i\omega t} = \cos(\omega t) - i\sin(\omega t)$

$F(\omega) = \int_{-\infty}^{\infty} f(t)(\cos\omega t - i\sin\omega t)\, dt$

$F(\omega) = \int_{-\infty}^{\infty} f(t)\cos(\omega t)\, dt - i\int_{-\infty}^{\infty} f(t)\sin(\omega t)\, dt.$

$\int_{-\infty}^{\infty} (\cos \pi x)[\cos \pi x]\, dt = \infty.$

Fourier : $F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t}.\, dt$. Laplace : $F(s) = \int_{0}^{\infty} f(t)\, e^{-st}.\, dt$

Laplace Transform of First order :-

Applications of Z-Transform:

Difference equation: -

$$\Delta y_{n+2} + y_n = 2.$$

$$\Delta f(x) = f(x+h) - f(x).$$

Linear difference equations : It is defined as an equation in which y_{n+1}, y_{n+2} .... etc occur to the first degree only & separately.

$y_{n+k} + a_1 y_{n+k-1} + a_2 y_{n+k-2} + \dots + a_k y_n = f(n) \to (1).$

Thus, the general solu^n of (1) is $y_n = C.F + P.I.$

$4u_n - u_{n+2} = 0$, with $u_0 = 0$ & $u_1 = 2$.

Taking Z-T , $4Z(u_n) - Z(u_{n+2}) = Z(0) = 0$

WKT, $Z(u_{n+k}) = z^k\left[U(z) - u_0 - \frac{u_1}{z} \cdots \frac{u_{k-1}}{z^{k-1}}\right].$

$4U(z) - z^2\left[U(z) - u_0 - \frac{u_1}{z}\right] = 0$

$4U(z) - z^2\left[U(z) - 0 - \frac{2}{z}\right] = 0$

The Z-Transform of Sequence using Matlab :-

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