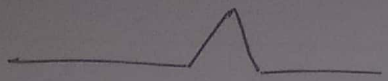
DSP

Fourier series Gibbs phenomina using python.



$$f(x) \cong \sum_{K=0}^{100} a_K \cos\left(\frac{2\pi x}{L}\right) + b_K \sin\left(\frac{K 2\pi x}{L}\right)$$

$$a_K = \langle f(x) \cos\left(\frac{K 2\pi x}{L}\right)\rangle \quad , b_K = \langle f(x) \sin\left(\frac{K 2\pi x}{L}\right)\rangle$$

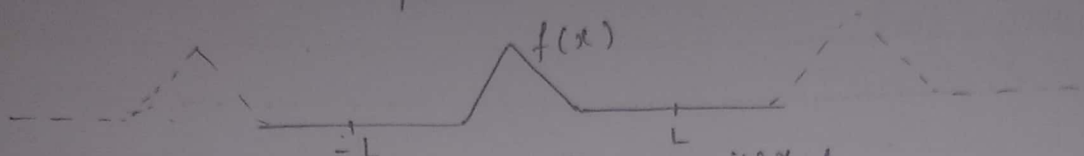
```
import numpy as np
import mat plot lib. pxplot as plt
plt . reparams ['figure . figsize'] * (0.8)
plt. reparams. updata ({'font.size' : 10})
dx = 0.0;
L = 2*np.pi
x = np. arange (0.L+dx, dx)
n = len(x)
nquart = int (np. floar (n/4))
f = np. zeros_linke(x)
f (nqart : 3*nquart ]*}
Ao = np. sum (f * np. ones_like (k)} *dx * 2/n.
fFS = Ao/2 * np.ones_like (f)
for k in range (1,101) ;
Ak = np. sum (f * np.cos (2*np.pi*k * x / w} * dx* 2/h.
Bk = np. sum (f * np. sin (2*np*pi *k*x /L } *dx*2/h
fFS = fFS * Ak* np.cos (2*k *np*pi*x/L) + Bk * npsin(2*k*np.pi*x/L}
Plt . plot (x,f,color = 'k' linewidth = 2}
plt.plot (x. fFS.'=', color = 'r', linewidth 1.5}
plt.show()
```

Fourier transform:

$$f(x) = \sum_{k=-\infty}^{\infty} C_k e^{i\pi x/L}$$

$$C_k = \tfrac{1}{2\pi} f(x)\, \psi_k \Rightarrow \tfrac{1}{2L} \int_{-L}^{L} \underbrace{f(x)\, e^{-jk\pi x/L}}_{\psi_k} dx$$

Fourier transform Derivatives.



$$\hat{f}(\omega) = F(f(x)) = \int_{-\infty}^{\infty} f(x)\, e^{-j\omega x}\, dx.$$

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

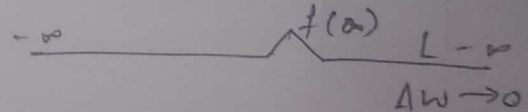
$$F\left(\tfrac{d}{dx} f(x)\right) = \int_{-\infty}^{\infty} \underbrace{\tfrac{df}{dx}}_{dv}\, \underbrace{e^{-j\omega x}}_{u}\, dx$$

$$\underset{\text{(PDE)}}{u_{tt} = C u_{xx}} \xRightarrow{F} \hat{u}_{tt} = -\omega^2 \hat{u}$$

$$u(x,t) \xRightarrow{F} \hat{u}(\omega, t)$$

Fourier Transform & convolution.

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



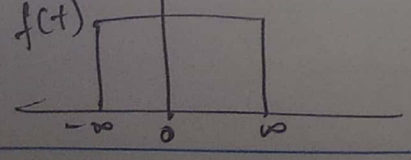
$$f(\omega) = F(f(x)) = \int_{-\infty}^{\infty} f(x)\, e^{-j\omega x}\, dx.$$

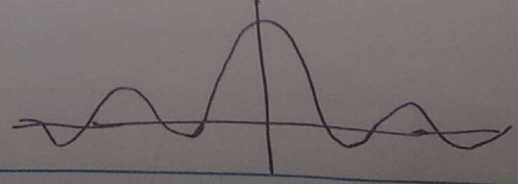
$$f(K) = F^{-1}(\hat{f}(\omega)) = \frac{1}{2\pi} \int_{-\infty}^{\infty} \hat{f}(\omega)\, d\omega.$$

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

$$= f * g.$$

Intuition of fourier.





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

$$e^{-i\omega t} = \cos(-\omega t) + \sin(\omega t)$$

Application of Z-transform.

- Uses to analysis of digital filters
- Used to simulate the continuous systems.
- Helps in system design and analysis & also checks the systems stability.

Python:

HTML templates:

from flask import flak, render_template.

→ return render_template ("home.html")

→ return render_template ("about.html").

Scanned with CamScanner