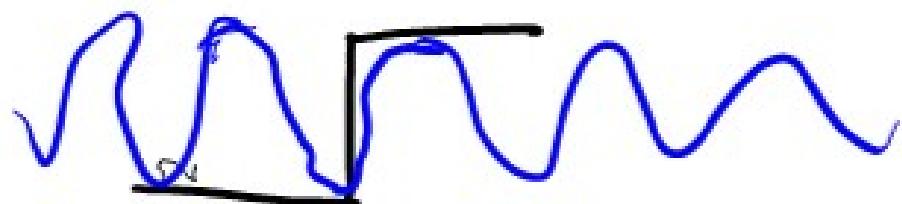


The Fourier Transform

$$F(\nu) = \int_{-\infty}^{\infty} f(t) e^{-j2\pi\nu t} dt \quad \text{'Overlap' integral}$$

$$f(t) = \int_{-\infty}^{\infty} F(\nu) e^{j2\pi\nu t} d\nu \quad \text{'reconstruction' integral}$$

Sharp features need high freq.



Sharp \leftrightarrow broad

useful properties

Linear: $h(t) = af(t) + b.g(t)$

$$H(v) = a.F(v) + b.G(v)$$

Convolution: $h(t) = g(t) * f(t) = \int_{-\infty}^{\infty} f(\tau)g(t-\tau)d\tau$

$$H(v) = F(v)G(v)$$

Derivative: $f(t) = \int_{-\infty}^{\infty} F(v) e^{j2\pi vt} dv \quad d/dt$

$$f'(t) = \int_{-\infty}^{\infty} \cancel{j2\pi v F(v)} e^{j2\pi vt} dv$$

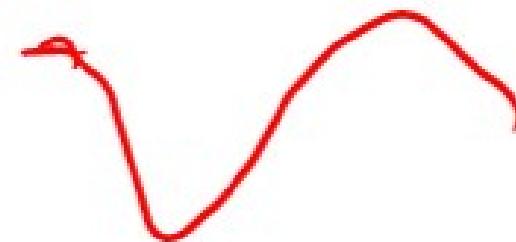
$$F(f'(t)) = j2\pi v F(v)$$

$$\mathcal{F}\left(\int f(t)dt\right) = \frac{F(v)}{j2\pi v}$$



$$A \sin(2\pi v t)$$

LTI



$$B \sin(2\pi vt + \phi)$$

$$\mathcal{F}(1) = \delta(v)$$

$$\mathcal{F}(\delta) = 1$$

$$\mathcal{F}(\text{square}) = \text{sinc}$$

Parseval's theorem

$$\int_{-\infty}^{\infty} |f(t)|^2 dt = \int_{-\infty}^{\infty} |F(v)|^2 dv$$

↳ if $f(t)$ is a voltage, $P = \frac{V^2}{R}$

∴ $|F(v)|^2$ must also be 'power'

Power Spectral Density

"The PSD is the Fourier Transform of the auto-correlation"

$$T_{xx}(v) = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T f(t+v) \cdot f^*(t) dt$$

$$S_{xx}(f) = \mathcal{F}(T_{xx}(t))$$

$$f(t) \rightarrow V$$

$$R(v) \rightarrow V \cdot S$$

$$T_{xx}(v) \rightarrow V^2 \frac{S}{S} \Rightarrow V^2$$

$$S_{xx}(f) \rightarrow V^2 \cdot S \Rightarrow \frac{V^3}{Hz}$$

$$A_{xx}(f) = \sqrt{S_{xx}(f)} \Rightarrow \frac{V}{\sqrt{\text{Hz}}}$$

→ can be integrated

$$V_{rms} = \sqrt{\int_{f_1}^{f_2} [\tilde{v}(f)]^2 df}$$

↳ A.S.D