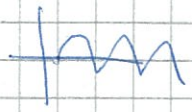
EXAMPLE: SPECTRUM OF SINUSOID



$$v(t) = A\cos(\omega_0 t)$$

$$\frac{1}{N}\sum_{n=1}^{N} \mathcal{E}\{v(k)v(k-\tau)\} = \frac{1}{N}\sum_{n=1}^{N} A^2\cos(\omega_0 k)\cos(\omega_0(k-\tau))$$

$$\frac{1}{2}\left[\cos(2\omega_0 k - \omega_0\tau) + \cos(\omega_0\tau)\right]$$

$$\bar{\mathcal{E}}\, v(t)v(t-\tau) = \frac{A^2}{2}\cos\omega_0\tau = R_v(\tau)$$

$$\Phi_v(\omega) = \sum_{\tau=-\infty}^{\infty} \frac{A^2}{2}\cos(\omega_0\tau)e^{-j\omega\tau} = \frac{A^2}{4}\left[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)\right]2\pi$$

$$\left(\delta(x) = \frac{1}{2\pi}\sum_{-\infty}^{\infty} e^{jnx}\right)$$

on $[-\pi, \pi]$

STATIONARY STOCHASTIC PROCESS

$$v(t) = H(q)\,e(t)$$

$$\mathcal{E}\, v(t)v(t-\tau) = \ldots = \lambda\sum_{n=0}^{\infty} h(k)h(k-\tau)$$

$$\Phi_v(\omega) = \sum_{\tau=-\infty}^{\infty} \lambda e^{-j\omega\tau}\sum_{k} h(k)h(k-\tau) =$$

$$= \lambda\sum_{\tau=-\infty}^{\infty}\sum_{k=\max(0,\tau)}^{\infty} h(k)e^{-j\omega k}h(k-\tau)e^{j(k-\tau)\omega} = \ldots\,(k-\tau=s)\ldots =$$

$$= \lambda\sum_{s=0}^{\infty} h(s)e^{j\omega s}\sum_{k=0}^{\infty} h(k)e^{-j\omega k} = \lambda\left|H(e^{j\omega})\right|^2$$

MIXED DET + STOCH SIGNAL:

$$s(t) = v(t) + w(t)$$

$$\Phi_s(\omega) = \Phi_v(\omega) + \Phi_w(\omega)$$

TRANSFORMATION OF SPECTRUM BY LINEAR SYSTEM

$$s(t) = G(q)\,w(t)$$

- w: q. ST. $\Phi_w(\omega)$
- G: STABLE TF (LTI)