RESÚMEN FÓRMULAS ASYS:

CONVOLUCIÓN:

- DISCRETOS → $y[n] = x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]\,h[n-k]$
- CONTINUOS → $y(t) = x(t) * h(t) = \int_{\tau=-\infty}^{\infty} x(\tau)\,h(t-\tau)\,d\tau$
- CONVOLUCIÓN POR SEÑAL IMPULSO → $x[n] * A\delta[n-n_0] = \sum_{k=-\infty}^{\infty} x[k]A\delta[n-n_0-k] = Ax[n-n_0]$
- PROPIEDADES →
  - $[x[n] * h_1[n]] * h_2[n] = x[n] * [h_1[n] * h_2[n]]$
  - $x[n] * h[n] = h[n] * x[n]$
  - $\alpha(x_1[n] * x_2[n]) = [\alpha x_1[n]] * x_2[n] = x_1[n] * [\alpha x_2[n]]$
  - $y[n] = x_1[n] * x_2[n] \Rightarrow x_1[n-n_1] * x_2[n-n_2] = y[n-n_1-n_2]$
- RELACIÓN CON RESP. INDICIAL → $g(t) = y(t)\big|_{x(t)=u(t)} = h(t) * u(t)$
- SERIE Y PARALELO →
  - SERIE → $h_{eq}[n] = h_1[n] * h_2[n]$
  - PARALELO → $h_{eq}[n] = h_1[n] + h_2[n]$

CORRELACIÓN Y AUTOCORRELACIÓN

- CORRELACIÓN CRUZADA →
  - ALEATORIAS →
    - DISCR. → $R_{xy}[k] = \lim_{N\to\infty} \frac{1}{N} \sum_{n=0}^{N-1} x[n]\,y[n+k]$
    - CONT. → $R_{xy}(\tau) = \lim_{T\to\infty} \frac{1}{2T} \int_{t=-T}^{T} x(t)\,y(t+\tau)\,dt$
  - PERIÓDICAS →
    - DISCR. → $R_{xy}[k] = \frac{1}{N} \sum_{n=0}^{N-1} x[n]\,y[n+k]$
    - CONT. → $R_{xy}(\tau) = \frac{1}{2T} \int_{t=-T}^{T} x(t)\,y(t+\tau)\,dt$
  - SEÑALES DE ENERGÍA APERIÓDICAS →
    - DISCR. → $R_{xy}[k] = \sum_{n=-\infty}^{\infty} x[n]\,y[n+k]$
    - CONT. → $R_{xy}(\tau) = \int_{t=-\infty}^{\infty} x(t)\,y(t+\tau)\,dt$
- RELACIÓN CON CONVOLUCIÓN →
  - $R_{xy}(\tau) = x(-\tau) * y(\tau)$
  - $R_{yx}(\tau) = x(\tau) * y(-\tau)$
  - $R_{xy}(\tau) = R_{yx}(-\tau)$

[en $\tau = 0$ da la energía]

[AUTOCORRELACIÓN es lo mismo pero se hace con la misma función]

PROCESOS ESTOCÁSTICOS

- ESTADÍSTICAS
  - VALOR ESPERADO $\rightarrow$ $E[X(t_1)] = \lim_{N\to\infty} \frac{1}{N}\sum_{i=1}^{N} x_i(t_1)$
  - PROM. LINEAL TEMPORAL (MEDIA) $\rightarrow$ $\mu_X(t) = E[X(t)] = \lim_{N\to\infty} \frac{1}{N}\sum_{i=1}^{N} x_i(t)$ es DEL ENSAMBLE
  - PROM. CUADRÁTICO TEMPORAL $\rightarrow$ $P_X(t) = E[X^2(t)] = \lim_{N\to\infty} \frac{1}{N}\sum_{i=1}^{N} x_i^2(t)$
  - VARIANZA TEMP. $\rightarrow$ $\sigma_X^2(t) = E[X(t)-\mu_X(t)]^2 = E[X^2(t)] - \mu_X^2(t)$
- FUNC. DE AUTOCORRELACIÓN $\rightarrow$ $\phi_{XX}(t_1,t_2) = E[X(t_1)X(t_2)] = \lim_{N\to\infty} \frac{1}{N}\sum_{i=1}^{N} x_i(t_1)\,x_i(t_2)$
- AUTOCOVARIANZA $\rightarrow$ $C_{XX}(t_1,t_2) = E[(X(t_1)-\mu_1)(X(t_2)-\mu_2)] = \lim_{N\to\infty} \frac{1}{N}\sum_{i=1}^{N} (x(t_1)-\mu_1)(x(t_2)-\mu_2)$
  - $C_{XX}(t_1,t_2) = \sigma^2 x_1$ en el ORIGEN, $t_1 = t_2$
  - $C_{XX}(t_1,t_2) = \phi_{XX}(t_1,t_2) - \mu_1\mu_2$
- SISTEMAS LTI
  - $\mu_Y(t) = h(t) * \mu_X(t)$
  - para $x(t)$ estacionario $\rightarrow$ $\mu_X(t) = \mu_X \Rightarrow \mu_Y = \mu_X \int_{t=-\infty}^{\infty} h(t)$
  - $R_{YY}(\tau) = R_{hh}(\tau) * R_{XX}(\tau)$; $R_{hh}(\tau) = h(\tau) * h(-\tau)$; $R_{XY}(\tau) = h(-\tau) * R_{XX}(\tau)$; $R_{YX}(\tau) = h(\tau) * R_{XX}(\tau)$

SERIES DE FOURIER

$$f(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty}\left[a_k \cos(k\omega_0 t) + b_k \operatorname{sen}(k\omega_0 t)\right]$$

$$a_m = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\cos(m\omega_0 t)\,dt \qquad a_0 = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\,dt$$

$$b_m = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\operatorname{sen}(m\omega_0 t)\,dt \qquad b_0 = 0$$

TENER en CUENTA
- INTEGRAR IMPAR en T_0 ANULA LA INTEGRAR
- $\cos(m\omega_0 t)$ es PAR y $\operatorname{sen}(m\omega_0 t)$ es IMPAR
- IMPAR x IMPAR = PAR; IMPAR x PAR = IMPAR; PAR x PAR = PAR
  - $f(t)$ IMPAR $\rightarrow$ $\overbrace{a_m = 0}^{a_0 = 0}$; $b_m \neq 0$
  - $f(t)$ PAR $\rightarrow$ $b_m = 0$; $a_m \neq 0$
- FUNCIÓN IMPAR AFECTADA por cte $\rightarrow$ $a_m = 0$ pero $a_0 \neq 0$

$[a_0 = 2.\text{cte}]$

POTENCIA $\rightarrow$ $$P = \frac{1}{T_0}\int_{-T_0/2}^{T_0/2} |f(t)|^2\,dt = \frac{1}{4}a_0^2 + \frac{1}{2}\sum(a_m^2 + b_m^2)$$

CONVOLUCIÓN

$$y[m] = x[m] * h[m] = \sum_{k=-\infty}^{\infty} x[k]\,h[m-k]$$

$$y(t) = x(t) * h(t) = \int_{\tau=-\infty}^{\infty} x(\tau)\,h(t-\tau)\,d\tau$$

FCC y FAC

$$R_{xy}[k] = \lim_{N\to\infty} \frac{1}{N} \sum_{m=0}^{N-1} x[m]\,y[m+k]$$

$$R_{xy}(\tau) = \lim_{T\to\infty} \frac{1}{2T} \int_{t=-T}^{T} x(t)\,y(t+\tau)\,dt$$

ALEATORIAS ; p/ PERIÓDICAS NO TOMAR LÍMITE, p/ SEÑ DE E INTEGRAR de $-\infty$ a ∞

ESTOCÁSTICOS

ESTADÍSTICAS

$$E[x(t_1)] = \lim_{N\to\infty} \frac{1}{N} \sum_{l=1}^{N} x_l(t_1)$$

$$\mu_x(t) = E[x(t)] = \lim_{N\to\infty} \frac{1}{N} \sum_{l=1}^{N} x_l(t)$$

$$P_x(t) = E[x^2(t)] = \lim_{N\to\infty} \frac{1}{N} \sum_{l=1}^{N} x_l^2(t)$$

$$\sigma_x^2(t) = E[x(t) - \mu_x(t)]^2 = E[x^2(t)] - \mu_x^2(t)$$

FAC

$$\phi_{xx}(t_1,t_2) = E[x(t_1)\,x(t_2)] = \lim_{N\to\infty} \frac{1}{N} \sum_{l=1}^{N} x_l(t_1)\,x_l(t_2)$$

AUTOCOVARIANZA

$$C_{xx}(t_1,t_2) = \lim_{N\to\infty} \frac{1}{N} \sum_{l=1}^{N} [x(t_1)-\mu_1][x(t_2)-\mu_2]$$

$$C_{xx}(t_1,t_2) = \phi_{xx}(t_1,t_2) - \mu_1\mu_2$$

FOURIER

SDF

$$f(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty} [a_k\cos(k\omega_0 t) + b_k \operatorname{sen}(k\omega_0 t)]$$

COEFICIENTES

$$a_0 = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\,dt \; ; \; a_m = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\cos(m\omega_0 t)\,dt$$

$$b_0 = 0 \; ; \; b_m = \frac{2}{T_0}\int_{\langle T_0\rangle} f(t)\operatorname{sen}(m\omega_0 t)\,dt$$

POTENCIA

$$P = \frac{1}{T_0}\int_{-T_0/2}^{T_0/2} |f(t)|^2\,dt = \frac{1}{4}a_0^2 + \frac{1}{2}\sum (a_m^2 + b_m^2)$$