TINF Signali formule

Periodični signali

Snaga:

$$P = \lim_{k\to\infty}[\frac{1}{kT_0}k\int_0^{T_0}|x(t)|^2dt] = \frac{1}{T_0}\int_0^{T_0}|x(t)|^2dt = \sum_{k=-\infty}^{\infty}|c_k|^2 = ...$$

Još za slijed pravokutnih:

$$... = A^2\frac{\tau}{T}$$

Fourier parovi:

$$x(t) = sin(\omega_0 t) \longleftrightarrow -j\frac{A}{2}[\delta(f-f_0) - \delta(f+f_0)] = X(f)$$

$$x(t) = cos(\omega_0 t) \longleftrightarrow \frac{A}{2}[\delta(f-f_0) + \delta(f+f_0)]$$

Slučajni signali

Bijeli šum

$W(t)$ bijeli šum ako:

- $R_W(\tau) = C_1 * \delta(\tau)$
- $C_W(\tau) = C_2 * \delta(\tau)$

Svojstva:

- $\mu_W = 0$
- $R_W(\tau) = \sigma^2\delta(\tau)$
- $S_W(f) = \sigma^2\int_{-\infty}^{\infty}\delta(t)\exp^{-j2\pi ft}\,dt = \sigma^2$

Gaussova razdioba:

$$f_x(x) = \frac{1}{\sigma_X\sqrt{2\pi}}\exp^{-(x-\mu_X)^2/(2\sigma_X^2)}$$

Prijenos

Prijenosna funkcija:

$$H(f) = \int_{-\infty}^{\infty} h(t) \exp^{-j2\pi ft}\, dt$$

Amplitudni odziv RC:

$$20 \log \frac{|H(f)|}{|H(0)|} = 20 \log(|H(f)|)$$

$$|H(f)| = \begin{cases} 1, & \text{za } |f| \leq f_g \\ 0, & \text{za } |f| \geq f_g \end{cases}$$

Impulsni odziv i prijenosna funkcija

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

$$y(t) = x(t) * h(t)$$

$$Y(f) = X(f) * H(f)$$

Amplitudni odziv je parna funkcija frekvencije, a fazni odziv neparna:

$$|H(-f)| = |H(f)|$$

$$\theta(-f) = -\theta(f)$$

Ako je $X(t)$ stacionarni slučajni proces...

$$\mu_Y = \mu_X H(0)$$

$$S_Y(f) = S_X(f)|H(f)|^2$$

Ako na ulazu kanala dovedemo signal $x(t)$ čiji je spektar $X(f)$ definiran kao $X(f) = |X(f)| \exp^{j\varphi(f)}$, onda $Y(f)$ zadovoljava:

$$Y(f) = |Y(f)| \exp^{j\vartheta(f)}$$

$$|Y(F)| = |X(f)||H(f)|$$

$$\vartheta(f) = \varphi(f) - \theta(f)$$

Amplitudni odziv RC:

$$|H(f)| = |\frac{U_{\text{izlaz}}(f)}{U_{\text{ulaz}}(f)}| = \frac{1}{\sqrt{1 + (2\pi fRC)^2}}$$

Konverzije

U decibel (dB):

$$x \to 10 \log_{10}(x)$$

Jedinice

$$c_k \leftrightarrow [\frac{V}{Hz}]$$

$$S_X(f) \leftrightarrow [\frac{W}{Hz}]$$