Assignment 10

CS21BTECH11020 (Harsh Goyal)

June 27, 2022

LaTeX

Outline

Problem Statement

Papoulis Ch-9 Ex-9.37

The process $x(t)$ is normal with zero mean and $R_x(\tau) = Ie^{-\alpha|\tau|}\cos(\beta\tau)$. Show that if $y(t) = x^2(t)$. then $C_y(\tau) = I^2e^{-2\alpha|\tau|}(1 + \cos(2\beta\tau))$. Find $S_y(\omega)$.

Solution

We Know,

$$E\{x^2(t+\tau)x^2(t)\} = E\{x^2(t+\tau)\}E\{x^2(t)\} + 2E^2\{x^2(t+\tau)x^2(t)\} \quad (1)$$

Hence,

$$R_y(\tau) = R_x^2(0) + 2R_x^2(\tau) = I^2(1 + e^{-2\alpha|\tau|} + e^{-2\alpha|\tau|}cos(2\beta\tau)) \quad (2)$$

$$S_y(\omega) = \left[2\pi\delta(\omega) + \frac{4\alpha}{4\alpha^2 + \omega^2} + \frac{2\alpha}{4\alpha^2 + (\omega - 2\beta)^2} + \frac{2\alpha}{4\alpha^2 + (\omega + 2\beta)^2}\right] \quad (3)$$

Futhermore,

$$n_y = E\{x^2(t)\} = R_x(0) \quad (4)$$

$$C_y(\tau) = 2R_x^2(\tau) \quad (5)$$