

Power Spectrum of Complex Processes

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Based on
Probability, Random Variables and Random Signal Principles,
P.Z. Peebles,Jr. and B. Shi

Power Density Spectrum of a Complex Process $Z(t)$

N Gaussian random variables

Definition

$$S_{ZZ}(\omega) = \int_{-\infty}^{+\infty} R_{ZZ}(\tau) e^{-j\omega\tau} d\tau$$

$$R_{ZZ}(\tau) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} S_{ZZ}(\omega) e^{+j\omega\tau} d\omega$$

$$\hat{S}_{ZZ}(\omega) = \int_{-\infty}^{+\infty} \hat{R}_{ZZ}(\tau) e^{-j\omega\tau} d\tau$$

$$\hat{R}_{ZZ}(\tau) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \hat{S}_{ZZ}(\omega) e^{+j\omega\tau} d\omega$$

Power Density Spectrum of a Jointly WSS Complex Process

$Z_m(t)$ and $Z_n(t)$

N Gaussian random variables

Definition

$$S_{Z_m Z_n}(\omega) = \int_{-\infty}^{+\infty} R_{Z_m Z_n}(\tau) e^{-j\omega\tau} d\tau$$

$$R_{Z_m Z_n}(\tau) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} S_{Z_m Z_n}(\omega) e^{+j\omega\tau} d\omega$$

$$R_{Z_m Z_n}(\tau) \iff S_{Z_m Z_n}(\omega)$$

Pseudo Power Density Spectrum of a Jointly WSS Complex Process $Z_m(t)$ and $Z_n(t)$

N Gaussian random variables

Definition

$$\hat{S}_{Z_m Z_n}(\omega) = \int_{-\infty}^{+\infty} \hat{R}_{Z_m Z_n}(\tau) e^{-j\omega\tau} d\tau$$

$$\hat{R}_{Z_m Z_n}(\tau) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \hat{S}_{Z_m Z_n}(\omega) e^{+j\omega\tau} d\omega$$

$$\hat{R}_{Z_m Z_n}(\tau) \iff \hat{S}_{Z_m Z_n}(\omega)$$

