

Power Density Spectrum - Discrete Time

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

Bilateral z-Transform of $R_{XX}[n]$

N Gaussian random variables

Definition

$$S_{XX}(z) = \sum_{n=-\infty}^{\infty} R_{XX}[n]z^{-n}$$

Discrete Time Fourier Transform of $R_{XX}[n]$

N Gaussian random variables

Definition

$$S_{XX}(e^{j\Omega}) = \sum_{n=-\infty}^{\infty} R_{XX}[n] e^{-jn\Omega}$$

$$R_{XX}[n] = \frac{1}{2\pi} \int_{-\pi}^{+\pi} S_{XX}(e^{j\Omega}) e^{jn\Omega} d\Omega$$

Properties of Power Density Spectrum - DT

N Gaussian random variables

- ① $S_{XX}(e^{j\Omega}) \geq 0$
- ② $S_{XX}(e^{-j\Omega}) = S_{XX}(e^{+j\Omega})$ for real $X[n]$
- ③ $S_{XX}(e^{+j\Omega})$ is real
- ④ $\frac{1}{2\pi} \int_{-\pi}^{+\pi} S_{XX}(e^{j\Omega}) d\Omega = E[X^2[n]]$

