Lecture 9 - EE 179: Introduction to Communications - Spring 2009

Filtering WSS Processes, Gaussian Processes.

Lecture Outline

- **Filtering WSS Processes**
- **Gaussian Processes**
- **Random Processes in Communication Systems**
- **Examples: Computing SNR and probability of bit error**

1. **Filtering WSS processes**
   - For $X(t)$ a WSS process, passing $X(t)$ through a filter with impulse response $h(t)$ results in a WSS process $Y(t) = X(t) * h(t)$.
   - The corresponding PSD is $S_Y(f) = |H(f)|^2 S_X(f)$.

2. **Gaussian Random Process**
   - A random process $X(t)$ is Gaussian if for all times T and all functions $g(t)$ we get that $Y_g = \int_0^T g(t)X(t)dt$ is a Gaussian random variable.
   - Filtering a Gaussian process results in another Gaussian process.
   - Samples of a Gaussian random process are jointly Gaussian random variables.
   - Samples of a Gaussian random process that are uncorrelated are also independent.
   - WSS Gaussian processes are stationary.

3. **Random Processes in Communications:**
   - The signal-to-noise power ratio (SNR) of an analog communication system is determined by computing the integral of the PSD of the signal and the integral of the PSD of the noise.
   - In digital communication systems, the bit value is obtained by integrating the received signal, and the probability of bit error is obtained by integrating a Gaussian random process.

Main Points:

- Filtering of random processes similar to deterministic case.
- Integrating a Gaussian process results in a Gaussian random variable.
- Gaussian white noise is a common model for noise in communication systems.
- For analog systems, use random process analysis to determine SNR.
- For digital communications, use random process analysis to determine probability of bit error.