

# AM Communication Systems

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



## Definition

$$Z_{AM}(t) = [A_0 + x(t)] \cos(\omega_0 t + \theta_0)$$

$$Z_{AM}(t) = [A_0 + X(t)] \cos(\omega_0 t + \Theta_0)$$

$$Z_R(t) = G_{ch} Z_{AM}(t)$$

$$= G_{ch} [A_0 + X(t)] \cos(\omega_0 t + \Theta_0)$$

$$N(t) = N_c(t) \cos(\omega_0 t + \Theta_0) - N_s(t) \sin(\omega_0 t + \Theta_0)$$

# Noise Performance (1)

$N$  Gaussian random variables

## Definition

$$\begin{aligned} & Z_R(t) + N(t) \\ &= G_{ch} [A_0 + X(t) + N_c(t)] \cos(\omega_0 t + \Theta_0) \\ &\quad - N_s(t) \sin(\omega_0 t + \Theta_0) \\ &= A(t) \cos(\omega_0 t + \Theta_0 + \Psi(t)) \end{aligned}$$

# Noise Performance (2)

$N$  Gaussian random variables

## Definition

$$Z_R(t) + N(t) = A(t) \cos(\omega_0 t + \Theta_0 + \Psi(t))$$

$$\Psi(t) = \tan^{-1} \left\{ \frac{N_s(t)}{G_{ch} [A_0 + X(t) + N_c(t)]} \right\}$$

$$A(t) = \left\{ [G_{ch} [A_0 + X(t) + N_c(t)]]^2 + N_s^2(t) \right\}^{1/2}$$

$$A(t) = G_{ch} [A_0 + X(t)] \left\{ 1 + \frac{2N_c(t)}{G_{ch} [A_0 + X(t)]} + \frac{N_c^2(t) + N_s^2(t)}{G_{ch}^2 [A_0 + X(t)]^2} \right\}^{1/2}$$

# Noise Performance (3)

$N$  Gaussian random variables

## Definition

$$A(t) = G_{ch} [A_0 + X(t)] \left\{ 1 + \frac{2N_c(t)}{G_{ch} [A_0 + X(t)]} + \frac{N_c^2(t) + N_s^2(t)}{G_{ch}^2 [A_0 + X(t)]^2} \right\}^{1/2}$$

$$A(t) \simeq G_{ch} [A_0 + X(t)] + N_c(t)$$

$$Z_d(t) = G_{ch} [A_0 + X(t)]$$

$$N_d(t) = N_c(t)$$

# Signal to Noise Ratio (1)

$N$  Gaussian random variables

## Definition

$$S_0 = G_{ch}^2 \overline{X^2(t)}$$

$$N_0 = \overline{N_c^2(t)} = \overline{N_c^2(t)}$$

$$\left( \frac{S_0}{N_0} \right)_{AM} = \frac{G_{ch}^2 \overline{X^2(t)}}{\overline{N_c^2(t)}}$$



# Signal to Noise Ratio (2)

$N$  Gaussian random variables

## Definition

$$\left(\frac{S_0}{N_0}\right)_{AM} = \frac{G_{ch}^2 \overline{X^2(t)}}{N_c^2(t)}$$

$$\overline{N_c^2(t)} = \frac{1}{2\pi} \int_{\omega_0 - (W_{rec}/2)}^{\omega_0 + (W_{rec}/2)} (N_0/2) d\omega = \frac{N_0 W_{rec}}{2\pi}$$

$$\left(\frac{S_0}{N_0}\right)_{AM} = \frac{2\pi G_{ch}^2 \overline{X^2(t)}}{N_0 W_{rec}}$$



