AM Communication Systems

Young W Lim

February 12, 2020

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

Outline

Definition

$$Z_{AM}(t) = [A_0 + x(t)]\, cos\,(w_0 t + \theta_0)$$

$$Z_{AM}(t) = [A_0 + X(t)]\, cos\,(w_0 t + \Theta_0)$$

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

$$= G_{ch}\,[A_0 + X(t)]\, cos\,(w_0 t + \Theta_0)$$

$$N(t) = N_c(t) cos\,(w_0 t + \Theta_0) - N_s(t) sin\,(w_0 t + \Theta_0)$$

Definition

$$Z_R(t) + N(t)$$

$$= G_{ch}\left[A_0 + X(t) + N_c(t)\right] cos\left(w_0 t + \Theta_0\right)$$

$$- N_s(t) sin\left(w_0 t + \Theta_0\right)$$

$$= A(t)\cos\left(w_0 t + \Theta_0 + \Psi(t)\right)$$

Definition

$$Z_R(t) + N(t) = A(t)\cos\left(w_0 t + \Theta_0 + \Psi(t)\right)$$

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

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

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

Definition

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

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

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

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

Signal to Noise Ratio (1)

N Gaussian random variables

Definition

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

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

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

Definition

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

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

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