The Whitened-Matched Filter Channel Model

ORIGINAL PASSBAND MODEL:

TRANSMIT PULSE

\[ g(t) \]

\[ \tilde{s}(t) \]

\[ e^{j2\pi f_0 t} \]

\[ \Re\{ \cdot \} \]

Lowpass to bandpass

\[ s(t) \]

\[ c(t) \]

\[ h(t) \]

\[ h^*(-t) \]

\[ r(t) \]

\[ r_k \]

\[ \text{AWGN} \quad \text{(N}_0/2 \text{)} \]

\[ 2u(f) \]

\[ e^{-j2\pi f_0 t} \]

\[ \text{MATCHED FILTER} \]

\[ \text{MATCHED FILTER} \]

\[ \text{WHITENED-MATCHED FILTER (WMF)} \]

THE SMF CHANNEL MODEL

\[ \tilde{x}(k) = x(kT) = \langle h(t + kT), h(t) \rangle = \alpha^2 f_k * f_{-k^*} = \text{sampled autocorrelation function of received pulse shape} \]

\[ \alpha^2 \]

\[ F(z) \]

\[ \frac{1}{\alpha^2 F^*(1/z^*)} \]

\[ \text{THE WMF CHANNEL MODEL} \]

\[ \text{DEFINITIONS:} \]

\[ g(t) = \text{transmit pulse shape} \]

\[ c(t) = \text{impulse response of passband channel} \]

\[ \tilde{c}(t) = \text{complex envelope of } c(t), \text{ lowpass} \]

\[ h(t) = g(t) * \tilde{c}(t) = \text{received pulse shape} \]

\[ p(t) = h(t) * h^*(-t) = \text{autocorrelation function} = \text{“overall” pulse shape} \]

\[ x(k) = x(kT) = \langle h(t + kT), h(t) \rangle = \alpha^2 f_k * f_{-k^*} = \text{sampled autocorrelation function of received pulse shape} \]

\[ X(z) = \text{folded spectrum} = Z\text{-transform of } x(k) \]

\[ F(z) = \text{minimum-phase factor in factorization} \]

\[ X(z) = \alpha^2 F(z) F^*(1/z^*) \]