November 30, 2014

Abstract

1 Channel capacity optimization for single subband

For a given subband we can obtain the optimum sensing time which maximizes the probability of Pnf = (1- Pfa). The channel capacity for the subcahnnel kwill be:

$$C = \frac{T_f}{T_f + T_0} B_k \log_2(1+\gamma_k) \cdot P(H_0) \cdot (1 - P_f)$$

$$P_f = Q(\lambda)$$

s.t.

$$P_d = Q\left(\frac{\lambda - \mu}{\sigma}\right) = \hat{P}_d$$

Where:

$$\mu = \sqrt{\frac{N_k N_i}{N_i + N_k}}, \qquad \sigma = (1+\gamma_k)^2, \qquad N_k = B_k\ T_0, N_i = \textbf{Constant} \tag{1}$$

The optimal λ will be a function of the sensing time T_0.

$$\lambda = \sigma\ Q_{\text{inv}}(\hat{P}_d) + \mu = \sigma\ Q_{\text{inv}}(\hat{P}_d) + \sqrt{\frac{N_k N_i}{N_i + N_k}} \tag{2}$$

$$\lambda = \sigma\ Q_{\text{inv}}(\hat{P}_d) + \sqrt{\frac{\alpha}{\alpha+1}} B_k T_0 \tag{3}$$

with $N_i = \alpha N_k$

Replacing in the Capacity:

$$C = \frac{T_f}{T_f + T_0} R_k \cdot P(H_0) \cdot \left(1 - Q\left(\sigma\ Q_{\text{inv}}(\hat{P}_d) + \sqrt{\frac{\alpha}{\alpha+1}} B_k T_0\right)\right)$$

$$C' = T_f\ R_k\ P(H_0) \cdot \left[\frac{1}{T_f + T_0} \cdot \left(1 - Q\left(\sigma\ Q_{\text{inv}}(\hat{P}_d) + \sqrt{\frac{\alpha}{\alpha+1}} B_k T_0\right)\right)\right]' \tag{4}$$

$$C' = T_f \ R_k \ P(H_0) \cdot \left[\frac{\left(1 - Q\left(\sigma \ Q_{\text{inv}}(\hat{P}_d) + \sqrt{\frac{\alpha}{\alpha+1}} B_k T_0\right)\right)}{T_f + T_0} \right]' \tag{5}$$

$$C' = a_0 \cdot \left[\frac{-(Tf + T_0) \cdot Q'\left(a_1 + a_2 T_0\right) - \left(1 - Q\left(a_1 + a_2 T_0\right)\right)}{(T_f + T_0)^2} \right] \tag{6}$$