Uncertain Amplitude Signal

Consider the following processor structure:

$$\underline{x} \longrightarrow \boxed{\text{Processor}} \longrightarrow T(\underline{x})$$

Our goal is to decide presence or absence of a signal buried in uncorrelated Gaussian noise

where: H_0: $x(n) = w(n)$, $n = 0,1,\ldots, N-1$

H_1: $x(n) = A\, s(n) + w(n)$, $n = 0,1,\ldots, N-1$

$w(n)$ is an uncorrelated Gaussian noise sequence $\sim N(0,\sigma^2)$

$s(n) = \sin(2\pi f_c n + \phi)$, $f_c = 1/16$

$N = 128$.

I. Bayesian Approach (SKEA)

A. Assume $A \sim N(0,\sigma_A^2)$. Summarize briefly the analytical derivation of the test statistic and performance for the Bayes optimum SKEA detection receiver.

B. Plot the performance of the SKEP, SKEA, and Rayleigh fading signal optimum detectors:

1. P_D vs. P_F on normal probability paper for 10 log (ENR) = 10 dB.

2. P_D (linear) vs. ENR (dB) for $P_F = 10^{-1}$, 10^{-2}, and 10^{-3} and ENR from 0 to 20 dB.

Note: ENR is the expected energy-to-noise ratio.

II. Generalized Likelihood Ratio Test Approach (GLRT)

A. Summarize briefly the analytical derivation of the test statistic and performance for the GLRT for uncertain amplitude.

B. Plot the performance of the clairvoyant NP detector and the uncertain amplitude GLRT:

1. P_D vs. P_F on normal probability paper for 10 log (ENR) = 10 dB.

2. P_D (linear) vs. ENR (dB) for $P_F = 10^{-1}$, 10^{-2}, and 10^{-3} and ENR from 0 to 20 dB.

Note: ENR is the energy-to-noise ratio.

Notes:

1. Include grid line on your performance plots in Parts IB and IIB above.

2. Since they are derived under different assumptions about the uncertain parameters, it is best to keep the performance curves for Parts IB and IIB above on separate plots.