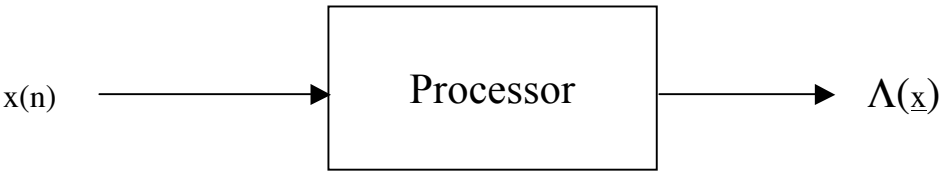
SKE and SKEP Processor Performance

Consider the following processor structure:



Our goal is to decide presence or absence of a sinusoid buried in white Gaussian noise

where: $x(n) = s(n) + n(n)$, $n = 0,1,\ldots, N-1$ and $N = 16$

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

$n(n)$ is an uncorrelated, Gaussian noise sequence ~$N(0,1)$

$SNR = A^2/2\sigma^2$, $\sigma^2 = 1$.

I. Select values of A such that:

A. $2E/N_0 = 4$

B. $2E/N_0 = 9$

What are the corresponding SNR's?

II. Determine the ROC performance of the following processors both theoretically and via Monte Carlo simulation (show your theoretical calculations and explain how you implemented your simulations):

A. Signal Known Exactly (SKE) ($\phi = 0$)

B. Signal Known Except for Phase (SKEP) (ϕ a random variable uniformly distributed between $-\pi$ and π)

When carrying out the simulations, generate estimates of $p(\Lambda|H_0)$ and $p(\Lambda|H_1)$ (or sufficient statistics for Λ), plot them, and from these (or their corresponding cumulative distribution functions) compute estimates of P_D and P_F. Compare your theoretical and simulation results.

Plot your ROC curves both on linear axes and on normal probability paper. See Chap. 2 in [1].

Reference

[1] S. Kay. *Fundamentals of Statistical Signal Processing. Vol. II: Detection Theory*. Prentice-Hall (1998).