2014 Fall - Introduction to Communication Systems

Homework 6

Matlab Exercises

The analysis of the effect of noise on angle modulation is particularly complex given the non linearity in the decoding.
Let's try to use Matlab to investigate this problem numerically:

Consider a square waveform phase modulated at carrier frequency $f_c = 250Hz$ at amplitude 5,varying modulation index and subject to an additive white noise with $N_0/2 = 1$ and do the following:

1) Plot the spectrum of the signal plus noise for different noise realizations and observe how the noise affects the frequency content of the signal. What is your intuition on how the phase information is corrupted by noise?
2) Extract the phase and the magnitude information as in (6.2.5) and plot the empirical distribution of the amplitude noise $V_n(t)$ and the phase noise $\Phi_n(t)$. Remember that here t is discrete and a multiple of the sampling frequency t_s, so you can plot the empirical distribution of the finitely many time instances.
3) Plot the sample distribution of frequency noise corresponding to FM modulation. What is the difference in the empirical distribution of the phase and the frequency noise?
4) Verify the approximation in the first line of (6.2.5) by varying the amplitude of the noise. Refer to Fig. 6.3 to explain your findings.
5) Obtain the plot in Fig. 6.4 by numerical simulations how precise is this approximation as the amplitude of the signal component changes? how about when the modulation index changes?
6) Fix the carrier amplitude and plot the numerically evaluated SNR as the noise variance increases for PM modulation.
7) Fix the modulation depth and plot the numerically evaluated SNR as the noise variance increases for PM modulation.
8) Fix the carrier amplitude and plot the numerically evaluated SNR as the noise variance increases for FM modulation.
9) Fix the modulation depth and plot the numerically evaluated SNR as the noise variance increases for FM modulation.

Workbook Exercises

Do exercise 6.3 and 6.5,