

Statistical Inference
(EECE5612)
Spring 2021

Homework 6a
(Assigned March 21, due March 28, 2022.)

Objective: The objective of this exercise is to experiment with frequency estimation.

Task: A radar system is employed to estimate the speed of a moving car. The radar transmits a known signal, waits for its return, and measures (estimates) the frequency offset between the transmitted signal and the return signal. It then infers the velocity of the reflection point (the radar is not moving). The transmitted signal is the 13-element Barker sequence modulated in-phase and quadrature onto a carrier of frequency $f_c = 20$ GHz. The Barker sequence is specified by the values $1, -1, 1, -1, 1, 1, -1, -1, 1, 1, 1, 1, 1$. Each element of the sequence is transmitted as a square pulse of duration $T = 0.4$ ms. The baseband signal $u(t)$ corresponding to the Barker sequence is stored in the Matlab file `hwk6-1.mat`, along with the baseband received signal $v(t)$. Both signals are represented by samples taken at $f_s = 20$ kHz. Your task is to estimate the Doppler frequency offset. At what relative speed is the car moving? Is it moving towards or away from the radar?

Reporting: Your report should be typed, and not exceed one single-sided page. It should be written in a professional manner. Figures and mathematical expressions should be used whenever meaningful. Figures should always have axes labeled in appropriate units (e.g. time [s], time [ms], frequency [Hz], frequency [kHz], SNR or SNR [dB], etc.). Include any Matlab code as an appendix. Please put your name on top of the report.