AA575: Satellite Navigation

Homework 2: Satellite Search and SNR

Assigned:
Due: Friday, October 17, 2011

A short segment of raw data from a GPS signal, which has been down-converted, is available on the course web site. Search for satellites with RRN 22 and 27, using the C/A code generator that you wrote for HW 1. At least one of these satellites is present in the data. The data were collected with the following specifications:

- Sampling rate: $f_s = 5.714286$ MHz
- IF carrier frequency (zero Doppler) $f_I = 1.405$ MHz
- Quanitization: "1.5 bits", meaning the data is quantized to the values of $\{-1, 0, 1\}$
- Length of data: 5 msec (28570 samples).

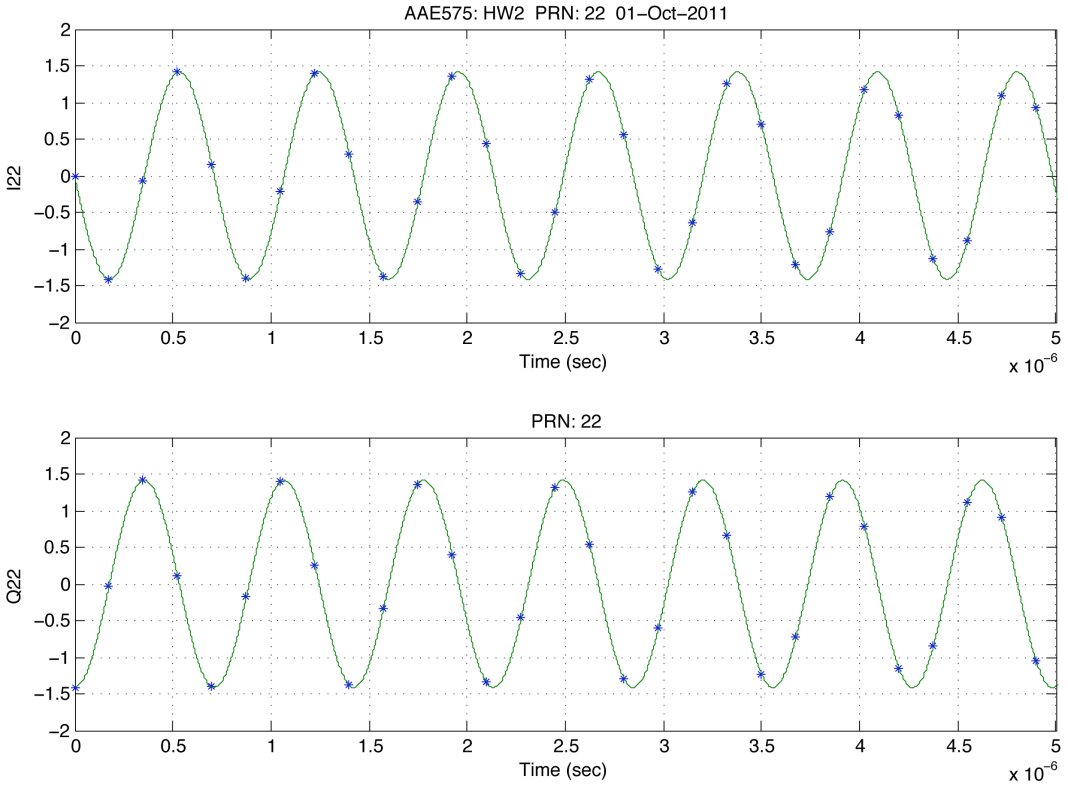
Problem 1 (15 Percent): Write a program, using the PRN code generators created in Homework 1, to generate the local inphase and quadrature signals:

$$I_L(t) = \sqrt{2}\sin\left[2\pi(f_I + \hat{f}_D)t\right] s(t - \hat{\tau})$$

$$Q_L(t) = \sqrt{2}\cos\left[2\pi(f_I + \hat{f}_D)t\right] s(t - \hat{\tau})$$

These functions should be able to produce these two signals for a given Doppler frequency ($\hat{f}_D$) and code delay ($\hat{\tau}$). Since you must multiply these with the sampled data, discrete values of I_L and Q_L must be generated **at the sampling rate**.

To check that this is being done correctly, the following plot shows the first 5×10^{-6} seconds of $I_L(t)$ and $Q_L(t)$ (solid lines) generated for PRN 22. The discrete values (asterix (*)) are produced at the sampling rate of $f_s = 5.714286$ MHz. $\hat{f}_D = 0$ and $\hat{\tau} = 0$ were used for this plot.



Problem 2 (55 Percent): Write a code to search through all of the delay and Doppler bins and use this to determine which satellites were visible at the time that the data was recorded. Provide plots which support your findings.

You can use the **circcorr** function to perform the cross-correlation.

Problem 3 (15 Percent): Write an explanation justifying your choice of the following parameters in the code above:

- The pre-detection integration time, T_I.
- The range of frequencies (maximum and minimum) searched.
- The number of frequency "bins" and their separation.

Problem 4 (15 Percent): From the data above, estimate the C/N_0 of each visible satellite. Estimate the Doppler frequency of each visible satellite, assuming that the local clock has no error relative to the GPS satellite clock.