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MECH 6970: Fundamentals of GPS
Lab 4

IF Simple Data Analysis

Part A

The IF data plotted over time appears like a whole lot of nothing. This is shown in Figure 1.

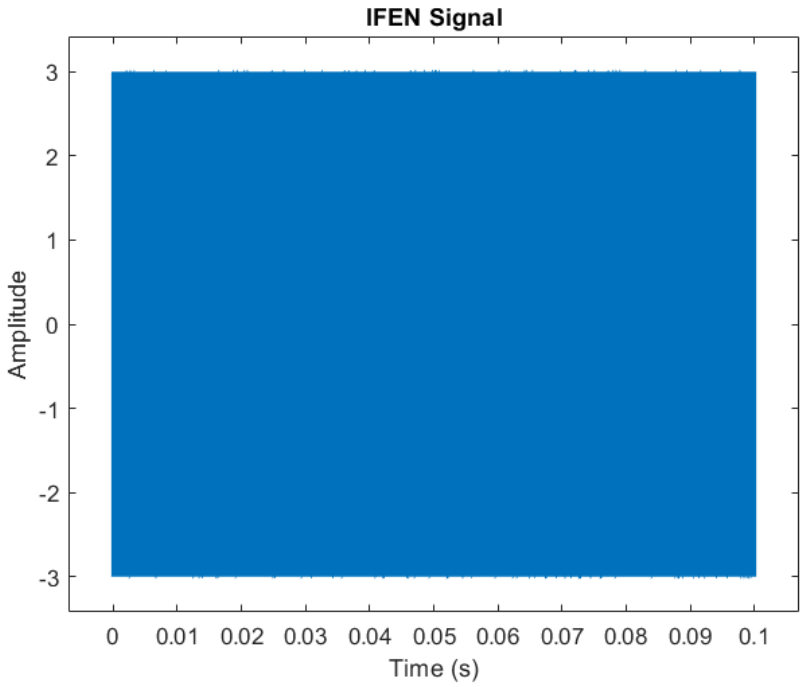

Figure 1: IFEN Data vs Time

Part B

The histogram of IFEN data is shown in Figure 2.

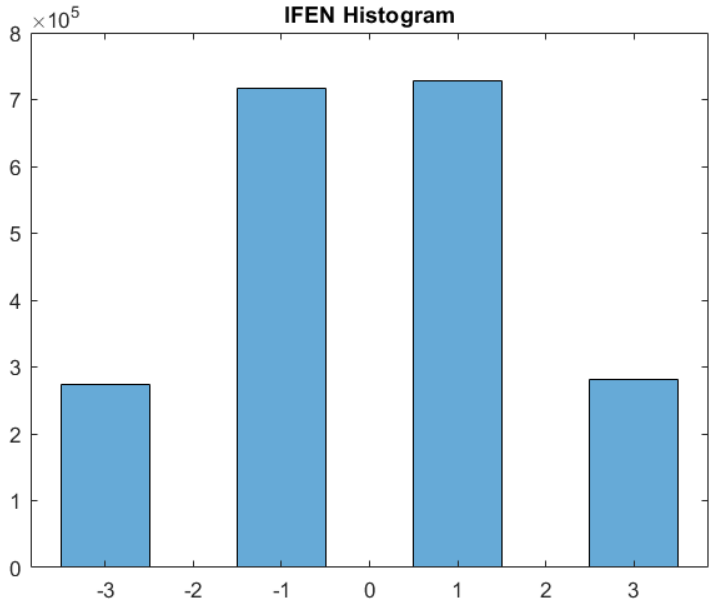

Figure 2: IFEN Data Histogram

Part C

The power spectral density of the IFEN data is shown in Figure 3.

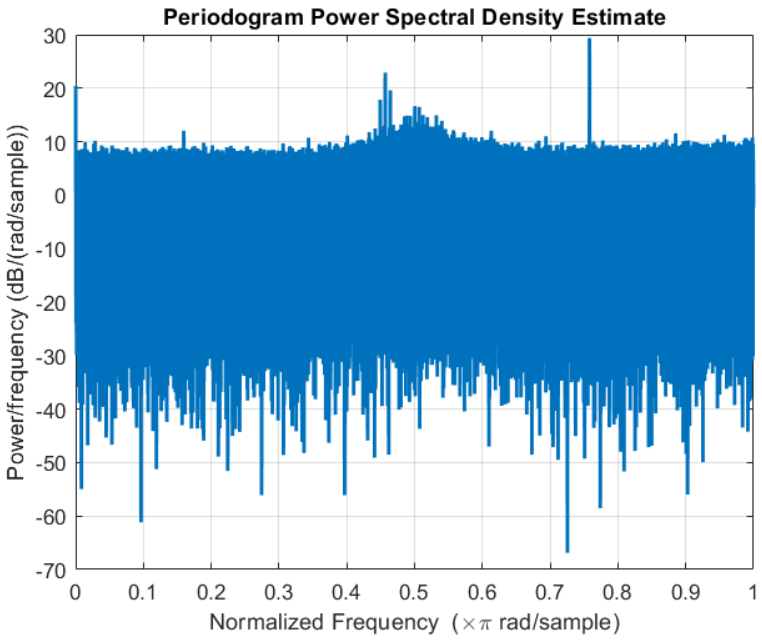

Figure 3: IFEN psd

Acquisition

Part A

The 8th satellite was acquired using a serial acquisition algorithm and the correlation spike is shown in Figure 4. This is for one 1ms integration period (a second was collected to ensure no data-bit transitions were polluting the auto correlation).

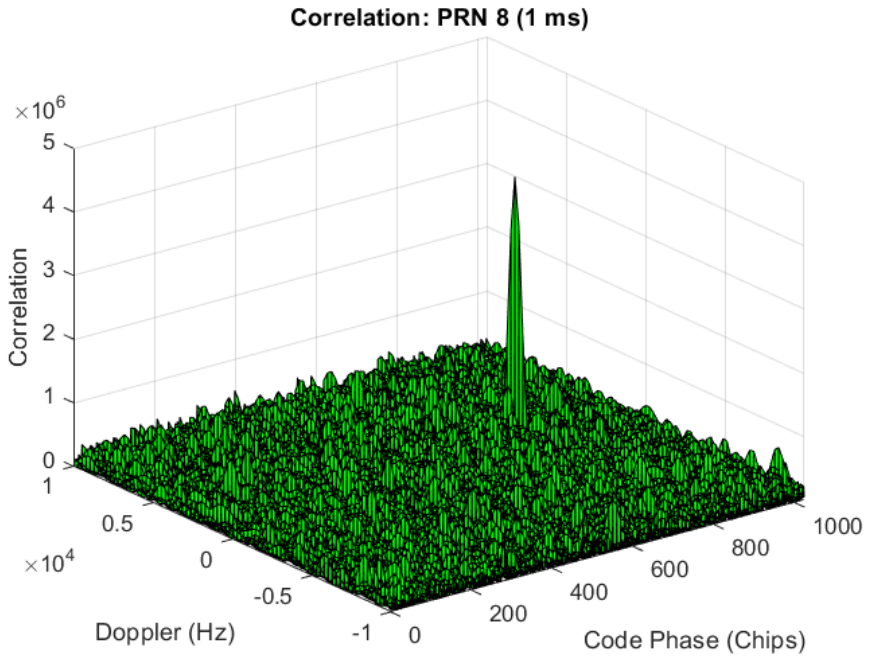

Figure 4: PRN 8 Autocorrelation 1 ms

Part B

Utilizing a 10ms window allows for improved noise rejection and a higher autocorrelation. This is seen in Figure 5

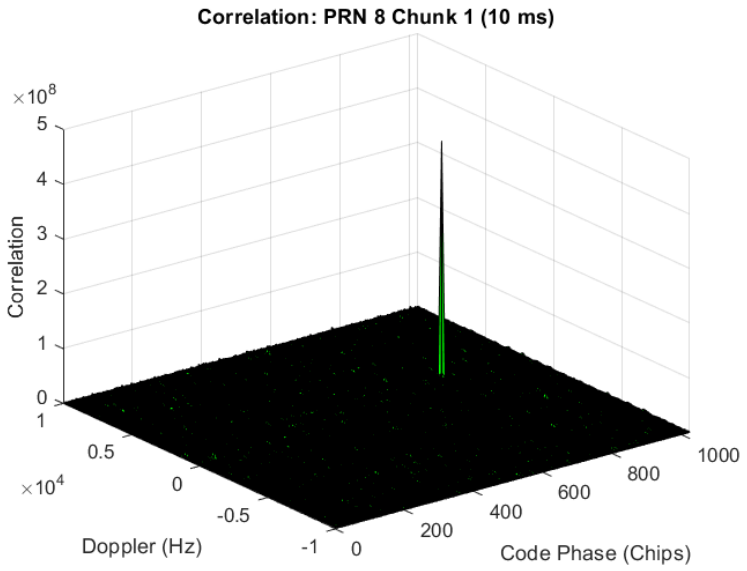

Figure 5: PRN 8 Autocorrelation 10 ms

The second chunk of this data in Figure 6 also has a strong peak. This means the data bit transition was either the same bit back to back or happened early/late in one of the chunks and therefore did not lower the correlation too drastically.

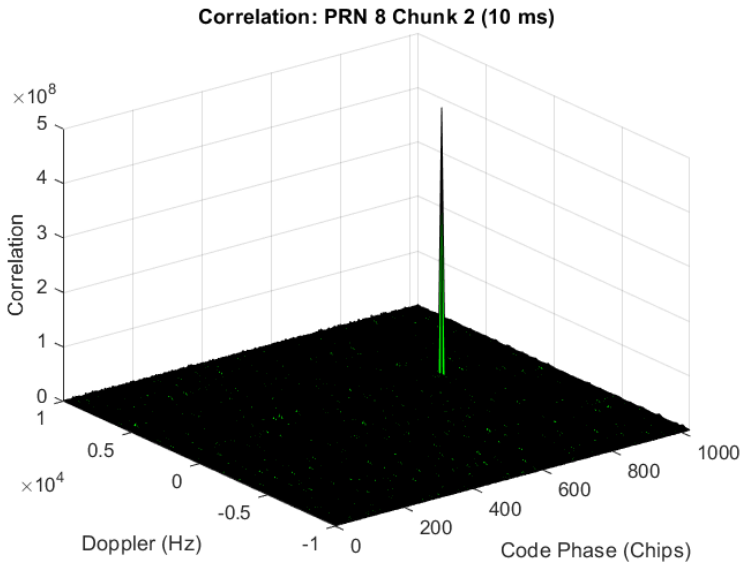

Figure 6: PRN 8 Autocorrelation 10 ms

Part C

With only 1ms of data, PRN 8 cannot be acquired with either noise magnitude ($1\sigma = 6$ or $1\sigma = 12$). This is seen in Figures 7 and 8

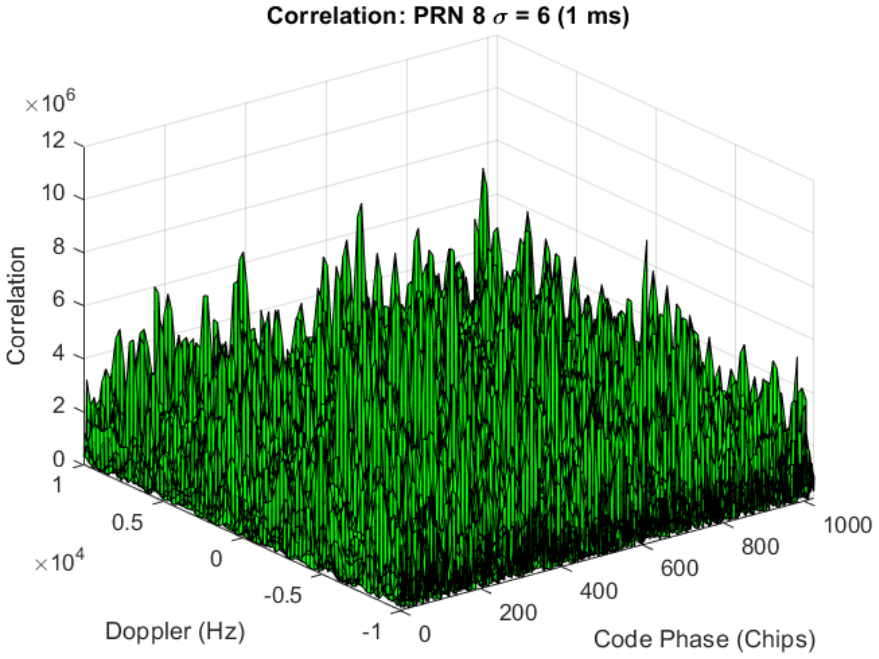

Figure 7: 1ms with $1\sigma = 6$

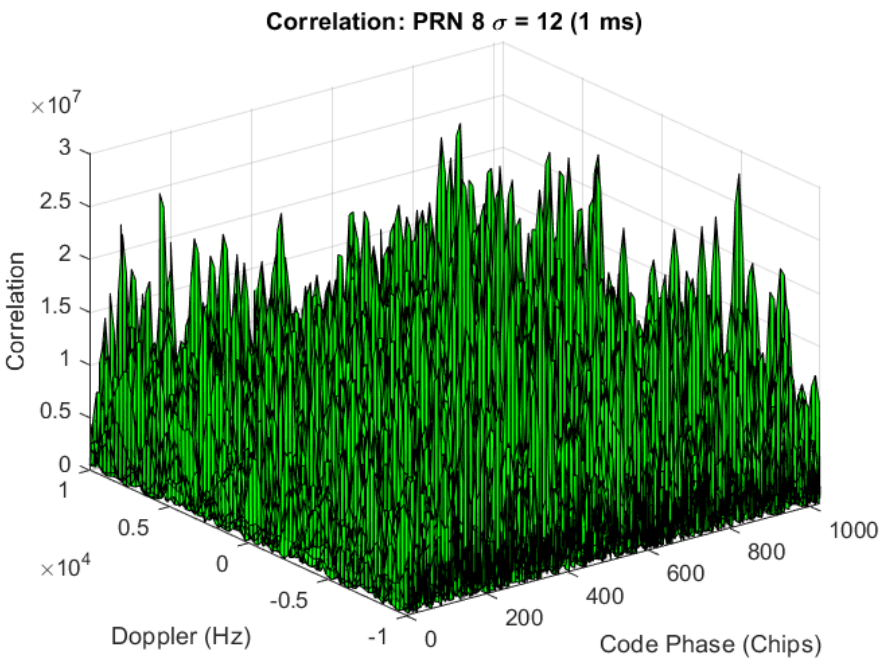

Figure 8: 1ms with $1\sigma = 12$

Repeating this for 10ms of data shows how a longer integration period aids in noise rejection. Acquisition is still possible with the lower noise value with the longer integration period (Figure 9). However, the higher prevents acquisition even at the largest possible integration lengt (Figure 10.

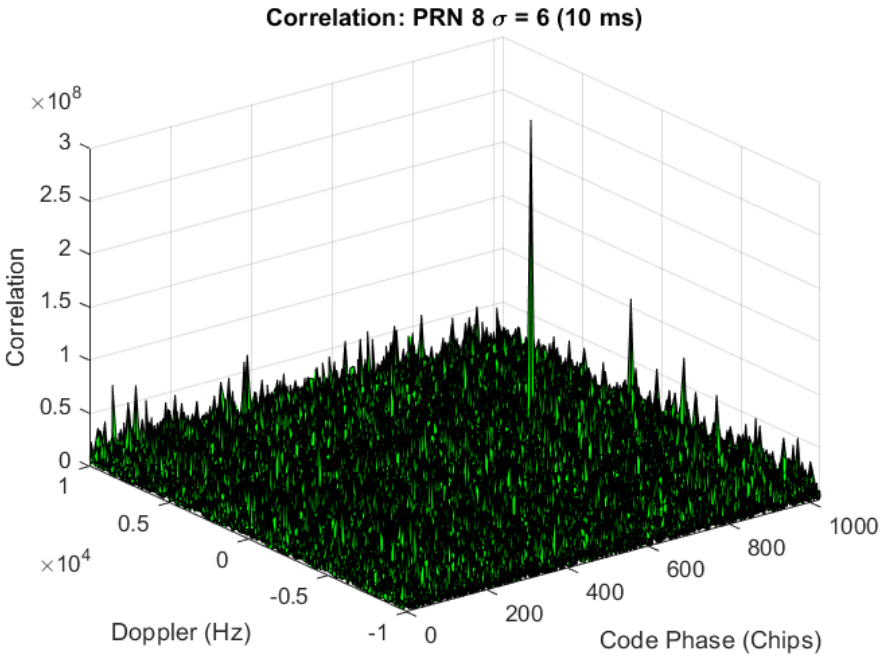

Figure 9: 10ms with $1\sigma = 6$

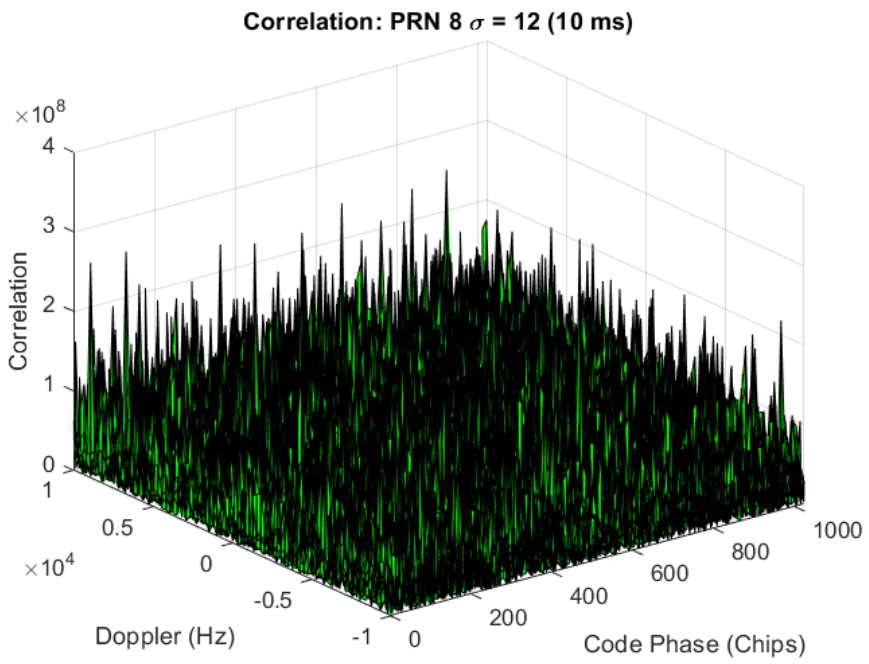

Figure 10: 10ms with $1\sigma = 12$

Part D

The selected satellites were 4, 7, and 27 with 10 ms of data. They are shown in Figures 11, 12, and 13. All were acquired successfully.

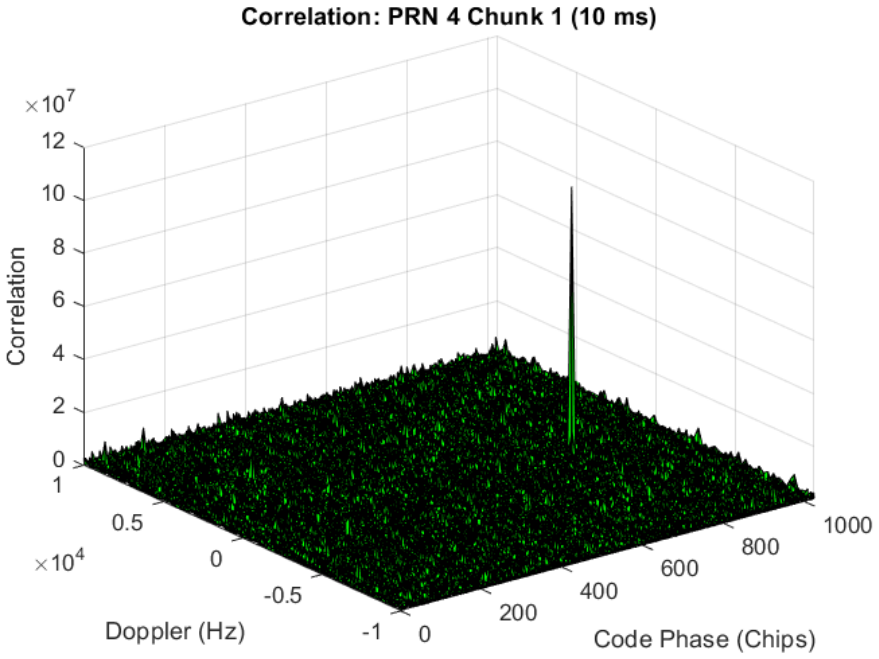

Figure 11: 10ms for PRN 4

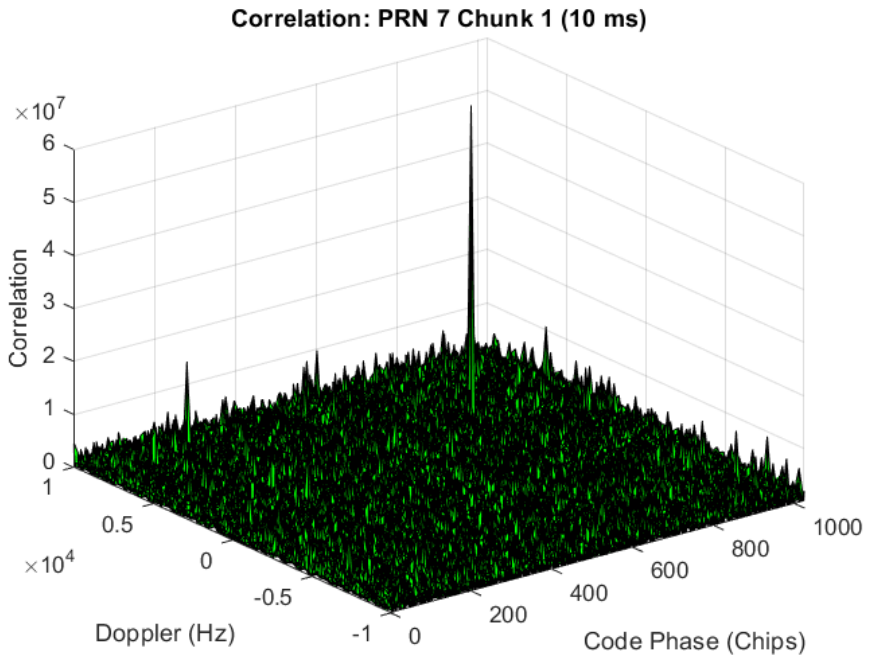

Figure 12: 10ms for PRN 7

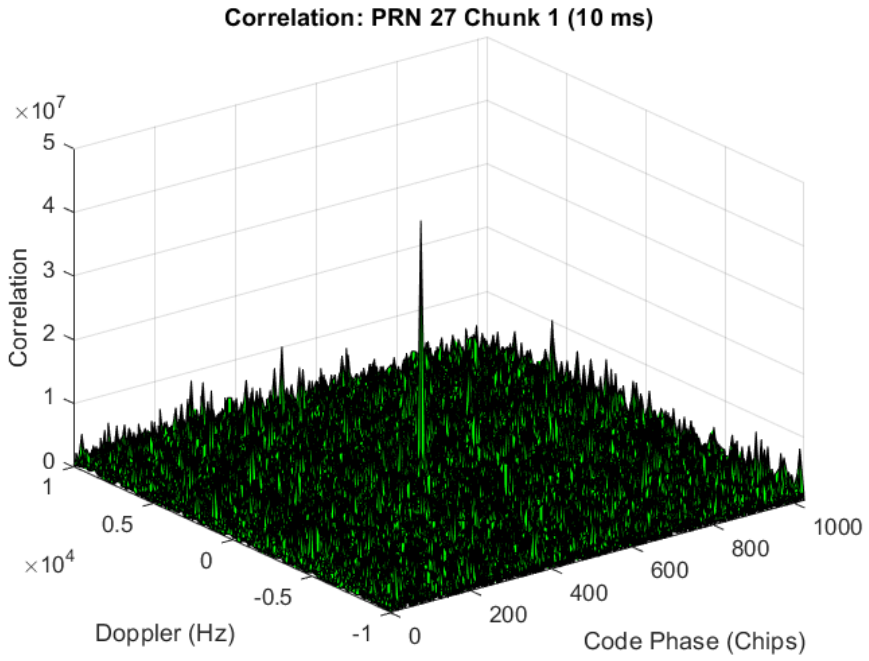

Figure 13: 10ms for PRN 27

Tracking

Part A

The data bits from SV 4 shown in Figure 14 were decoded and the week number and time of week (TOW) were determined.

$$Week\ \ \# = 2194 \qquad\qquad TOW = 331242$$

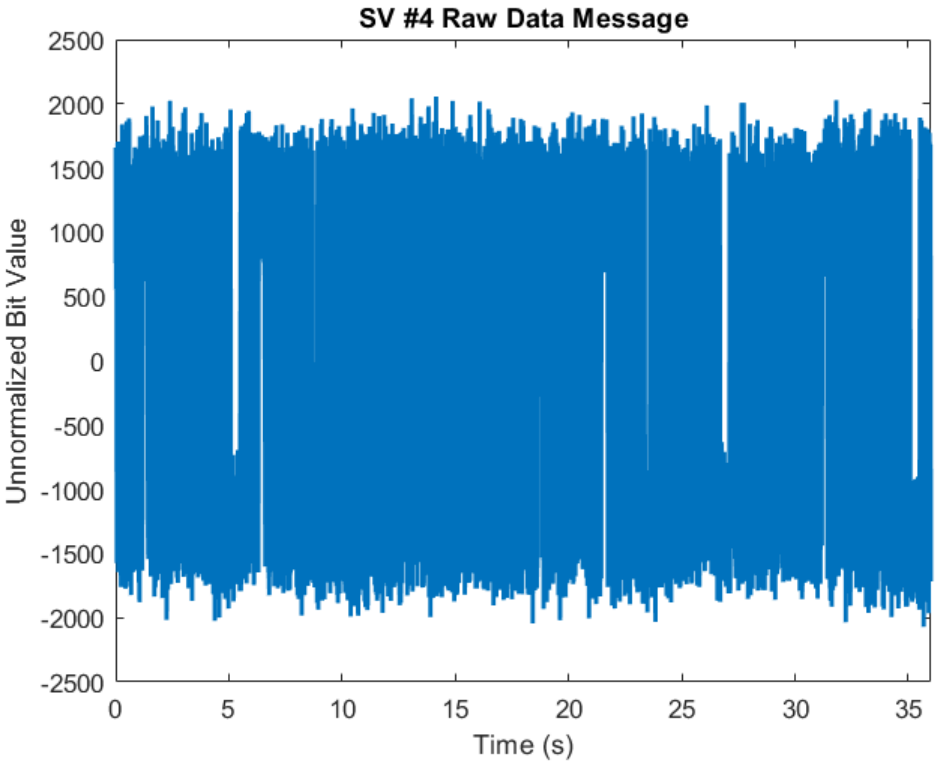

Figure 14: Raw Data Message for PRN 4

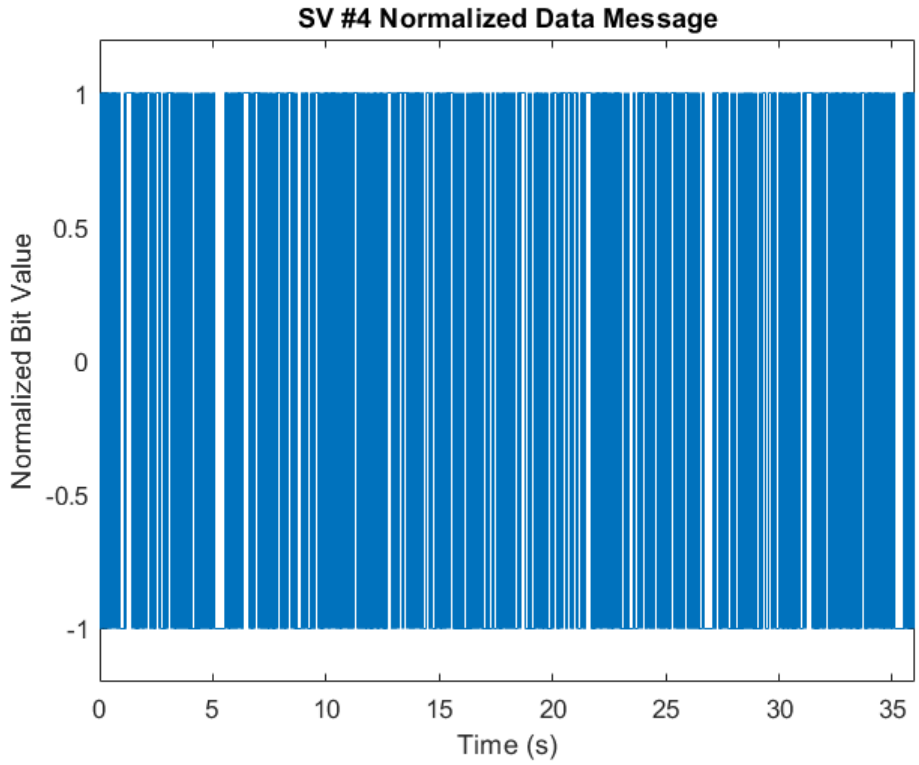

Figure 15: Normalized Data Message for PRN 4

Part B

The following figures display the carrier and doppler measurements over time for SV 8.

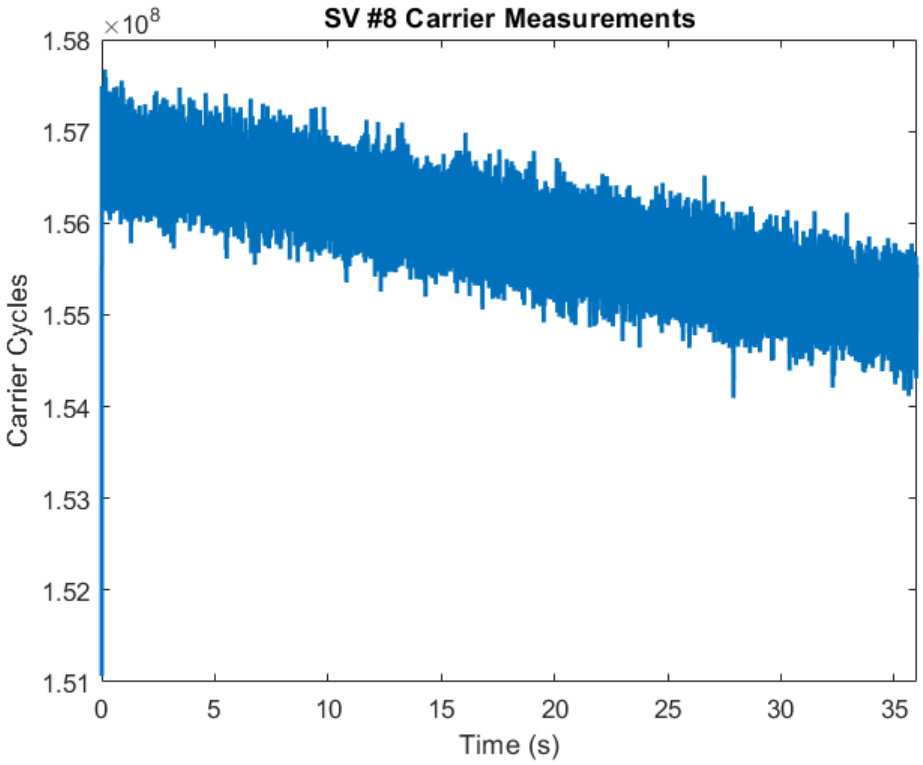

Figure 16: Carrier Measurement for PRN 8

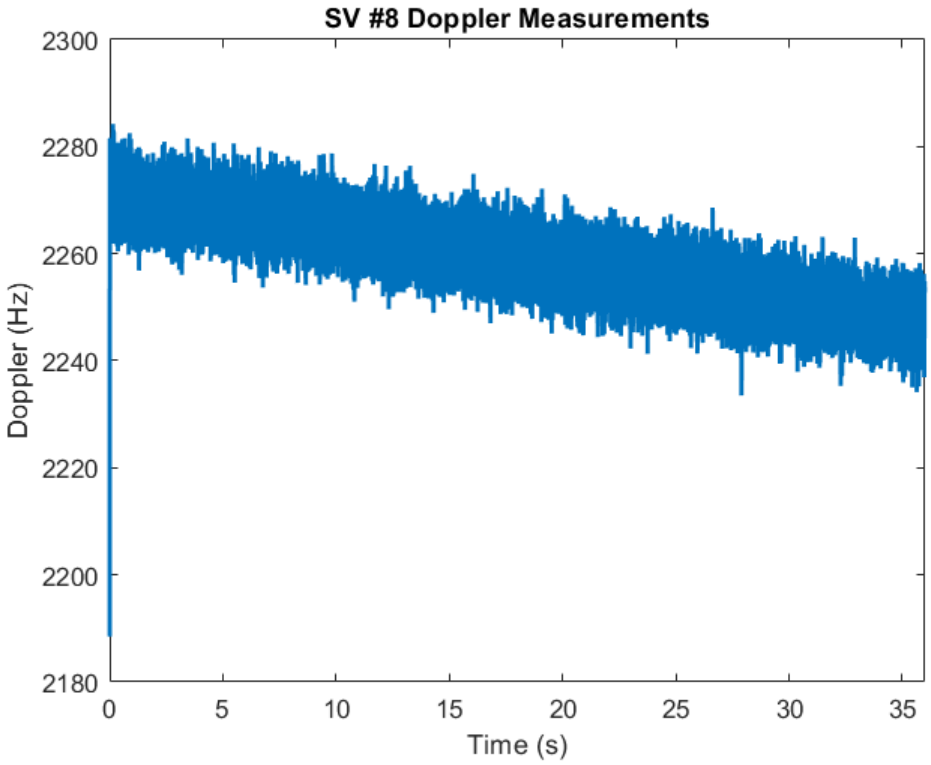

Figure 17: Doppler Measurement for PRN 8

Part C

We were able to track with 1 σ of noise added to the signal and extract data. This is significantly less than what we were able to acquire with. The data message for the 1 σ noise IF data is shown in Figure 18. No data was able to be acquired with a higher noise value.

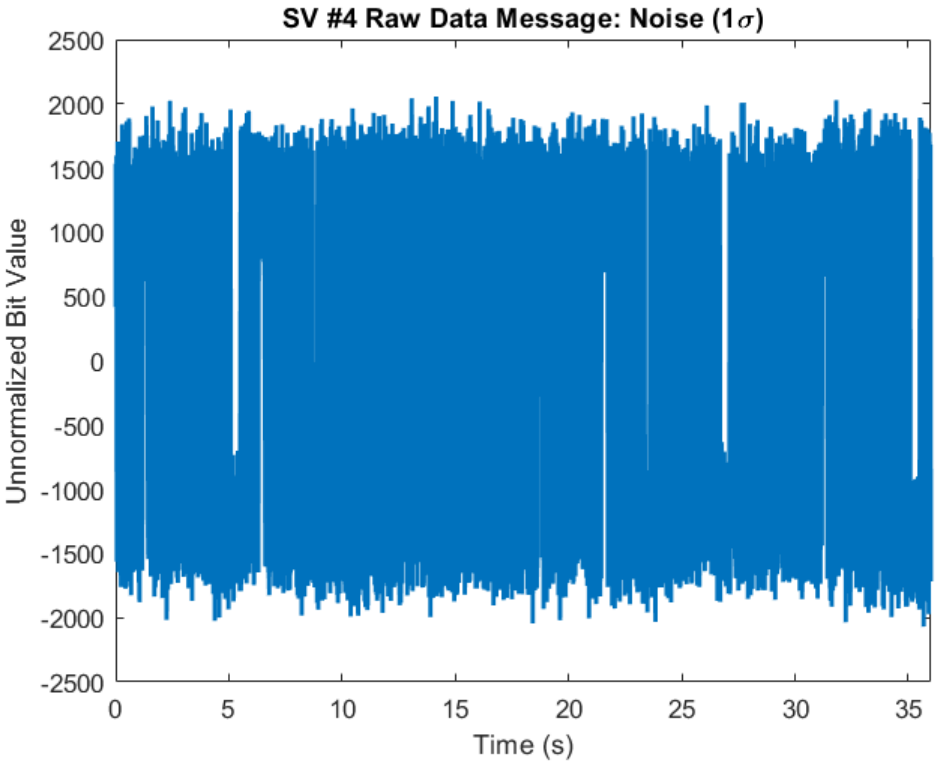

Figure 18: Raw Data Message with Noise for PRN 4

Part D

We were unable to calculate the pseudoranges to achieve a position solution.