GNSS IF Recorder Status Report
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Figure 1. GNSS IF Recorder


Figure 2. GNSS Antenna

Figures 1 and 2 show the GNSS IF Recorder and GNSS Antenna. GPS L1 IF data file "gps_l1_1ft_north_30Aug2020_908AM.dat" was processed for GNSS antenna movement in a conventional CTS xyz-axis reference system. Morning of recording had heavy overcast cloud conditions with some wind movement; accordingly, the GNSS antenna at 18 feet above ground level most likely had some minimal movement.

Figure 3 shows antenna movement on the X-axis over a 2 second span of time. Worst case deviation is +/- 1.2 inches.

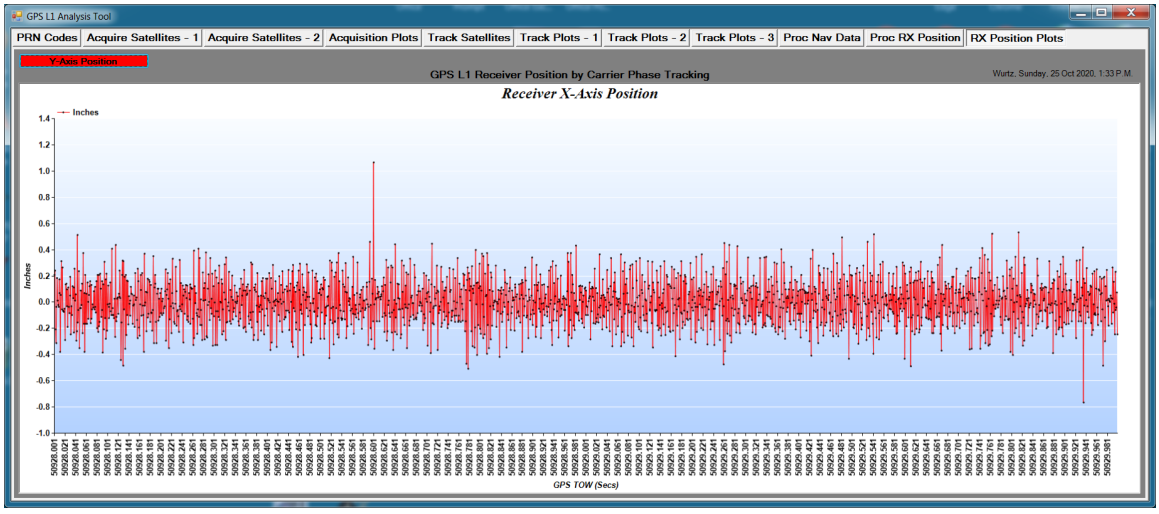

Figure 3. X-axis movement

Figure 4 shows movement on the Y-axis with a worst-case deviation of +/-1.9 inches. Figure 5 shows movement on the Z-axis with a worst-case deviation of +/-2.5 inches. With regard to a "slug test" projectile, position updates are in 1 msec increments immediately from projectile departure of the launch tube to impact. Since the IF data is post processed, the satellite acquisition and track lock time is zero.

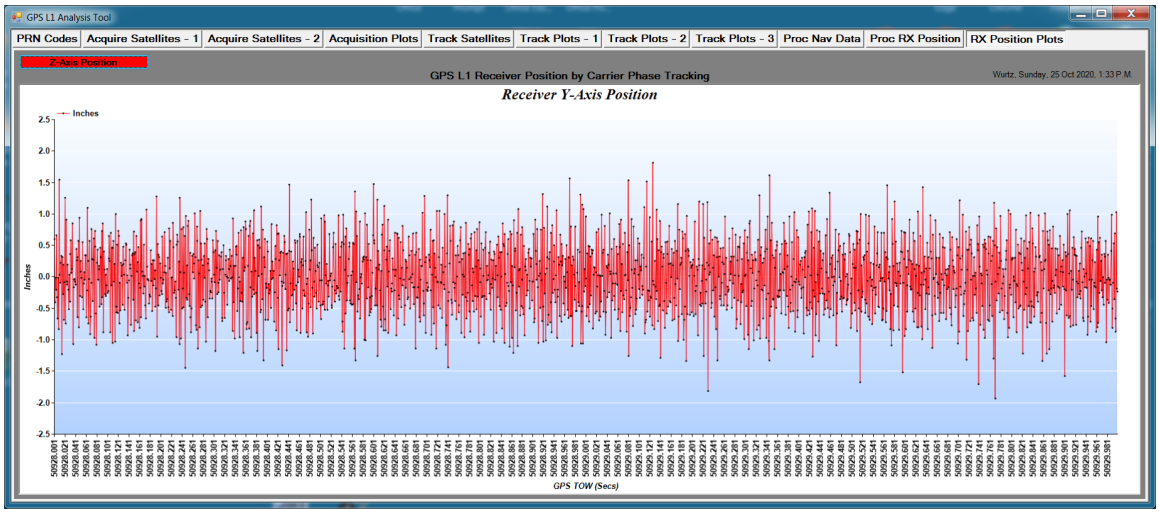

Figure 4. Y-axis movement

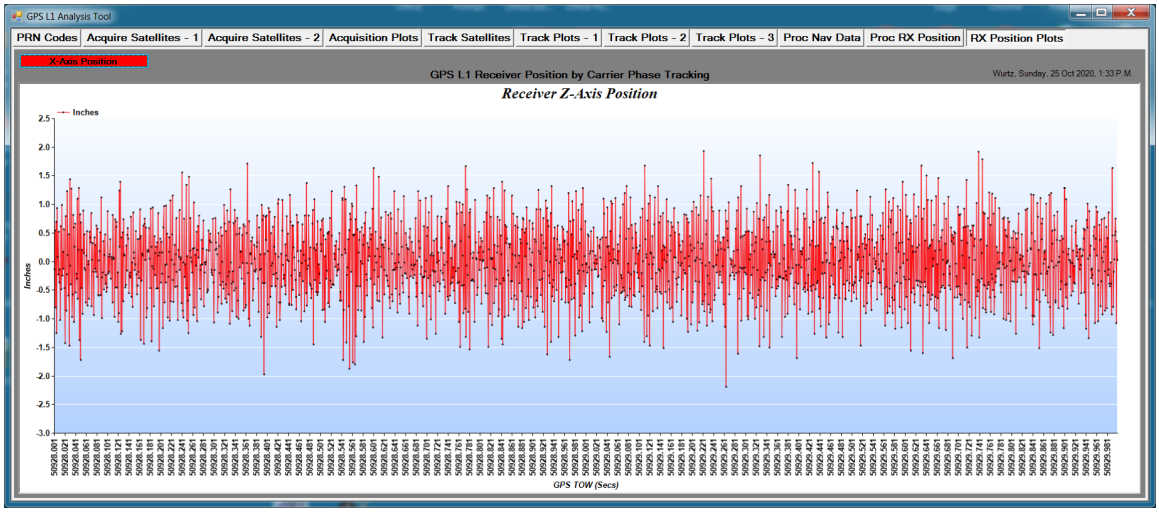

Figure 5. Z-axis movement

Some of the movement was from wind shaking the GNSS antenna. At this point, there is no correction for ionospheric and tropospheric distortion and differential correction has not been applied. Although the IF recording is over 11 minutes, ionospheric correction from the GPS L1 navigation messages in subframe 4, page 18, were not detected. For longer recordings, the GPS L1 ionospheric ephemeris data would provide for a 50% correction in distortion. Soon, GPS L2 IF data will be collected along with GPS L1 IF data by the GNSS IF recorder which will allow for 100% correction of

ionospheric distortion from very short IF recordings. Since the GPS IF data is post-processed, L2 will not be used to enhance acquisition and carrier-phase track lock times.

Receiver position is calculated by a simple least-square fit of observable equations for a minimum residual error. The covariance matrix is not weighted. Weight modifications and using a bit more sophisticated receiver position algorithm documented in the literature would provide some improvement in position error. Other receiver position algorithms will be investigated next, to improve position error and convergence when satellites are clustered.

Velocity and acceleration performance on xyz-axis were not provided in that the antenna is not moving. Shortly, some IF recordings from the Aeroflex GPSG-1000 simulator will be made with dynamic target movement to provide some velocity and acceleration performance metrics. Expectations are that it will be good since the carrier phase tracking loop is updated every 977.5 nsecs. L1 PRN code adjustments are made every 1 msec.

After the simultaneous L1 and L2 IF recordings and software updates are completed, differential GPS will be added to the system. Finally, the GPS Haigh-Farr antenna will be analyzed for phase distortion during position and rotational movement.