Software Defined GNSS Receiver

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Abstract
A software defined GNSS receiver to combat malicious spoofing, modeled in MATLAB, which receives GPS data and performs digital signal processing. The model locks the phase of the incoming signal, deciphers the CDMA encoded data, and interprets the relevant information. From this, the model produces a pulse per second signal that can be used to keep precise time for use in the power industry.

Hardware
The board we selected is the USRP B200 by Ettus Research.
- RF coverage 70 MHz - 6 GHz
- Flexible rate 12-bit ADC
- Built in daughter board is capable of baseband down conversion

Hardware Test Setup
To make sure that we were seeing the right data from our board we setup a test environment with a 900MHz carrier signal modulated by a 10 KHz square wave. This signal was going into the board and a high frequency oscilloscope, from this we were able to validate the incoming data.

Impact Analysis
- Space weather
  - Space weather can cause satellites to lose their ability to get an accurate signal to earth. It can also permanently damage a satellite.
- New satellites
  - New satellites added to constellations can complicate our design. We would need to update our firmware according to the PRN codes of these new satellites.

Early Late Detection
Once the incoming signal is phase locked, the radio can start locking onto the code phase. It does this using an Early Late Detector. This process multiplies the phase locked symbol with three code sequences separated by ½ chip. This creates an early, prompt, and late data stream. The early late detector then uses this data to determine if the tracker should delay a sample, skip a sample, or continue on the current sample offset. Using this method, the Early Late Detector locks on to the incoming PRN sequence.

Glossary
- GNSS – Global Navigation Satellite System
- GPS – Global Positioning System
- PLL – Phase Lock Loop
- CDMA – Code Division Multiple Access
- I – In-Phase Carrier
- Q – Quadrature-Phase Carrier
- PRN – Pseudo Random Number

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