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E156

Lab 1: Satellite Acquisition

**Part 1: PRN code offset**

1) The PRN code contains 1023 chips that repeat each millisecond. So, the chip rate is:

(1023 chips)/(1 millisecond) = 1.023 Mchips/sec.

2) The chip rate is 1.023 Mchips/sec, and the sample rate is 16.3676 Mhz. So, the samples per chip are:

(16.3676 Mhz)/ (1.023 Mchips/sec) = 15.996 samples ~= 16 samples

3) The mystery signal is coming from satellite 3.

4) The phase offset is 1677 half-chips (or 838.5 chips).

**Part 2: Carrier Frequency Modulation**

5) The pre-demodulated waveform is at a high frequency with a varying envelope. The change in chip value can be seen as the phase flips. The post-demodulated waveform has a higher frequency because it has been multiplied by a cosine. The frequency component that has been shifted towards the origin presents the value of the chips as the change in amplitude of the waveform.

Thus the first four chips of the signal are 0111.

6) The mystery signal is coming from satellite 7.

7) The phase offset is 1616 half-chips (or 808 chips).

**Part 3: GPS Satellite acquisition with known carrier frequency and phase**

8) No, it seems impossible to identify the first 4 chips by inspection.

9) We did not make significant changes from our code in part 2, because we were implementing In-phase and Quadrature demodulation in part 2. All we changed was check 1ms of the data set, since this one has about 5ms of data.

10) The mystery signal is coming from satellite 5.

11) The phase offset is 564 half-chips (or 282 chips).

**Part 4: GPS satellite acquisition with known carrier frequency**

12) The mystery signal is coming from satellite 10.

13) The phase offset is 53 half-chips (or 26.5 chips).

14) Yes, we get the same result. The purpose of the quadrature demodulation is obtain the energy in the quadrature component of the signal, which is necessary if we do not know the phase of the incoming signal.

**Part 5: Realistic GPS Satellite acquisition**

15) The mystery signal is coming from satellite 12.

16) The phase offset is 944 half-chips (or 472 chips).

17) The actual IF carrier frequency is 4128900 Hz (or 4.1289 MHz).

18) Our program takes 3.496427 seconds to run.

19) The time would increase by a factor of 2.5 (from changing the search from ±2KHz to ±5KHz) and by another factor of 16 (from changing the search of 2 satellites to all 32 satellites). So,

3.496427 \* 2.5 \* 16 = 139.8571 seconds.