Kinematic Positioning and Navigation – Winter 2018: Homework #4
GNSS

1. The table below contains the GPS ellipsoid height of a point on the OSU campus.
   a. Using NGS's GEOID 12B interactive computation utility (https://www.ngs.noaa.gov/cgi-bin/GEOID_STUFF/geoid12B_prompt1.prl) or VDatum (http://vdatum.noaa.gov/), compute the NAVD88 orthometric height of the point.
   b. Explain the difference between ellipsoid and orthometric heights and why the latter might be more useful.

Datum: NAD 83(2011) (EPOCH:2010.0000)		
Lat	Long	H_{el}
44˚ 33' 54.59871" N	123˚ 16' 22.06612" W	47.563 m

2. What new civil signals are being added as part of GPS modernization and what benefits do they provide over the legacy civil signal, L1 C/A?

3. What is the approximate travel time for a signal from a satellite directly overhead to an antenna on the ground for:
   a. GPS
   b. Galileo
   c. GLONASS

4. Below is the unscaled covariance matrix, $\mathbf{A} = (\mathbf{H}^{\mathrm{T}}\mathbf{H})^{-1}$, from a GPS solution for position in an ENU local level frame. What are the various DOP parameters (geometric, position, horizontal, vertical, and time), and what do these DOPs mean?

$$\mathbf{A} = \begin{bmatrix} 2.2426 & -0.5117 & 0.6548 & 0.5450 \\ -0.5117 & 0.69027 & 0.1870 & 0.0173 \\ 0.6548 & 0.1870 & 5.1334 & 3.1770 \\ 0.5450 & 0.0173 & 3.1770 & 4.1327 \end{bmatrix}$$

5. On the course Canvas site is a file called ca_prn_code.txt containing a C/A code PRN sequence from one of the GPS satellites. Download the "GPS C/A Code Generator" (Boschen, 2010) from the MATLAB Central File exchange, and use it to generate C/A codes for all SVs. Use MATLAB's cross-correlation function, xcorr, to answer the following questions:
   a. What GPS satellite generated the code in the ca_prn_code.txt file? Show the correlation plot to illustrate your answer.
   b. What is the shift between the PRN code in the file and that generated by the C/A code generator?