ASSIGNMENT 6 – GEOMETRIC RANGES AND CLOCKS

Due Date: Friday, October 25

This is an individual assignment worth 50 points. Please submit your answers and code to the D2L dropbox.

Last assignment:

- Learn to read the navigation message (RINEX navigation format)
- Compute the Cartesian position of a GPS satellite at any GPS time.
- Read the *a priori* Cartesian position of the GPS receiver from the header of the observation file (RINEX observation format)

In this assignment, your will turn this code into something that is more useful for GPS position estimation, i.e. reading observed pseudoranges in the RINEX files and computing the geometric range and satellite clock correction.

I recommend following these steps to structure your code

1. Define the name of the navigation message, brdc2640.12n.

2. Define the name of the observation file, darw264x.12o.

3. Read the contents of the navigation using provided code.

4. Read the *a priori* receiver position from the header of the RINEX observation file using the provided code.

5. This code will not be hardwired for a specific GPS time. Instead, you will evaluate all the observations for this first epoch. This means you need to figure out how the time (and other information) for the first epoch is stored.

6. For all the PRNs in the first epoch, make (and call) a function that calculates the geometric range (use instructions at the end of this assignment). Since your broadcast ephemeris has the information needed, calculate the relativity correction.

7. Write a function that calculates the satellite clock correction.

8. Figure out how to access the value for C1.

9. Output the answers in this format (to make it easier to read) as follows:

```
    fprintf(1,'%2.0f %15.3f %7.3f %12.3f %15.3f %7.3f \n',PRN,
geometric_range,relcorr,satcorr,C1,C1-geometric_range+satcorr)
```

10. Note that you can check some of your code by comparing answers with Ben Bradlee (broadcast2xva.p).

11. Please let me know if I have missed providing any needed files.

STEPS FOR COMPUTING GEOMETRIC RANGE

1) First compute the GPS satellite position (r_{GPS}) in ECEF at T_r based on the broadcast ephemeris code.

2) Use an *a priori* value for the receiver coordinates (from the header) to find geometric range $R = |r_{GPS} - r_{RX}|$.

3) Compute the time of transmission: $T_t = T_r - R/c$ (use the real speed of light)

4) Compute the satellite position at T_t in ECEF at T_t based on your broadcast ephemeris code.

5) Rotate the satellite position to ECEF at T_r. (ω_E is the rotation rate of the Earth, which was provided to you in the broadcast ephemeris code)

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{ECEF@t_R} = \begin{bmatrix} \cos\phi & \sin\phi & 0 \\ -\sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{ECEF@t_T}$$

where

$$\phi = \omega_E (t_R - t_T)$$

6) Compute a new geometric range using this position for r_{GPS}

7) Repeat steps 3-6 until convergence. (If it takes more than two iterations, something is wrong).