AAE6102 Lab Session Report

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As instructed, this lab session calculates the location of one receiver based upon GPS ephemeris data, and applies the least-square method to conduct the final estimation. The report first discussed briefly on the method, then the result.

Method

Given a set of orbital parameters and some other related constants, we first calculate the satellite position at the given GPS time, in which the calculation process could be referred to Table 20-IV in the ICD.pdf.

After calculating the positions of the satellite, we then apply iterative least-square method to conduct the final estimation of the receiver states. First we calculate the pseudorange, then we based on this pseudorange measurement to conduct least-square estimation. Successively, we set the difference of the measurement of pseudorange and the calculated of approximation from last epoch (or initial condition at t = 0) as the noisy measurement y, whereas the H matric is also constructed meanwhile. We then try to get the estimation δx by through differentiation, and apply it on the previous approximation. The process is repeated until δx is sufficiently small.

Result

Below display the results, extracted from the display output of MatLab:

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
CALCULATING USER POSITION AND CLOCK BIAS BASED ON EPHEMERIS DATA AND PSEUDORANGE

INITIAL STATE IN WGS 84 XYZ COORDINATE (m) and USER CLOCK BIAS (s):
-2694685.473
-4293642.366
 3857878.924
0


Iteration 1 result:
-2700399.8794
-4292561.4734
 3855273.0171
-0.0017327
```

```
Iteration 2 result:
-2700400.0078
-4292561.5721
 3855273.1222
-0.0017327


Iteration 3 result:
-2700400.0078
-4292561.5721
 3855273.1222
-0.0017327


ERROR < PRESET THRESHOLD, ITERATION ENDS
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

From above, the final estimation is $\begin{bmatrix} -2700400.0078 \\ -4292561.5721 \\ 3855273.1222 \end{bmatrix}$, with an estimated clock bias of -0.0017327 s, -519461.753926969 m, which approximates to the given reference estimation.