AH2923 GNSS

Assignment 6

Compute rover position using relative positioning with code and phase observations

Follow the procedure described in the document "**Relative positioning with GPS**" which is available in Canvas.

Use the data provided in the file "Diff AssignmentL1.xlsx" which is available in the Canvas. Use values in the file "Intermediate results.txt" for debugging your code.

The following is given:

- Code and phase observations from two receivers; the reference called REF (or A) and the rover called ROV (or B)
- Known coordinates for the reference receiver
- Approximate coordinates for the rover receiver
- Receiver clock errors for both receivers
- Known coordinates for five visible satellites
- Distances between the two receivers and the five satellites
- The weight matrix, P, with the weights of the observations to be used in the least squares estimation

Perform the following processing steps:

1. Synchronize observables from both receivers using equation (14) and using the same values for $\dot{\rho}$ for both receivers.
2. Compute single differences for both code and phase using equation (15).
3. Compute double differences using (18) and use satellite 20 as the reference satellite. So you compute the four double differences relative to satellite 20.
4. Compute the coefficients a_X, a_Y, a_Z using equation (12) and the single difference $\rho^s_{AB,0}$ by subtracting the two sets of distances between receivers and satellites.
5. Compute the double difference coefficients using equation (22) and $\rho^s_{AB,0}$ using equation (19).
6. Fill in matrix A and the vector L and compute a least squares solution of equation (21) using equation (26). A single iteration of the least squares solution is sufficient in this assignment since the approximate coordinates are close to the correct ones. In practice it is necessary to iterate a few times to minimize the linearization error.
7. Correct the approximate position of the rover with the corrections for X, Y, and Z given in the x-vector.
8. Compute the variance-covariance matrix (Qahat) from the least squares estimation of the float ambiguities (ahat). Then extract the 5 x 5 sub-matrix for the ambiguities.

9. Use the Matlab function LAMBDA provided by TU Delft (http://www.citg.tudelft.nl/over-faculteit/afdelingen/geoscience-and-remote-sensing/research-themes/gps/lambda-method/), which is also available in Canvas.

   Call the LAMBDA function e.g. using this call:

   ```
   [afixed,sqnorm,Ps,Qzhat,Z,nfixed,mu]=LAMBDA(ahat,Qahat);
   ```

10. Fill in the L vector using only the phase double differences and subtract the fixed ambiguities as they are now known.
11. Fill in the A matrix only for the phase double differences (it will be a 5x3 matrix since now we have 5 observations and three unknowns).
12. Fill in the P matrix only for the phase double differences, using the same weights as before.
13. Solve for X and correct the approximate position for ROV as it was given to estimate the position for ROV with the fixed ambiguities.
14. Perform ambiguity validation. With the above call to the LAMBDA function both the best and the next best set of ambiguities are returned (in variable *afixed*). Compute the residuals, (vector **v**), with both the best and the next best solution of fixed ambiguities. Then calculate the ratio test variable and evaluate the set of fixed ambiguities.

The report must contain:

- The receiver coordinates and their standard deviations computed using the best set of integer values of ambiguities
- The integer values of the ambiguities and their comparison with the float ambiguities
- Description of, and results from, the ratio test
- Discussion of the effect of the fixed ambiguities on the quality and reliability of the computed coordinates
- Your Matlab code