TU Delft **AE4872 (2017) – SATELLITE ORBIT DETERMINATION**

Assignment 2 - GPS single point positioning

Instructor
Dr.ir. Wouter van der Wal
w.vanderwal@tudelft.nl
office: 9.02
phone: 015-2782086

Group Size: 1 Student
Due: 13:30h, Monday 2 October, 2017

An electronic copy of the report should be submitted through Turnitin on Brightspace. Overdue submission will cause reduction of the lab grade by 20% per day after all GRACE days are used. It is preferred that you use MATLAB. Text as well as code should be your own work.

The objective is to determine the position of the SWARM A satellite with GPS pseudorange measurements using iterative least-squares. Several MATLAB and data files are provided. The Matlab file which reads the data: *Assignment2_start.m*. To complete the assignment you can continue working in this file.

To compute the position of the SWARM satellite you need to know the position of the GPS satellites. Since you are not computing the position in real-time you can make use of the precise GPS orbits and clock corrections provides by the International GNSS Service. GPS coordinates and clock corrections are contained in the file *igs19301.sp3*.
The main MATLAB file reads precise coordinates and clock corrections for the GPS satellites using the MATLAB function *readsp3.m* which needs the small MATLAB routine *read_strval.m.* After this the coordinates are contained in the variable *x_gps*, *y_gps* and *z_gps*, and the clock correction in *clock_correction*.

The SWARM GPS pseudoranges are contained in the file: *Data_SWARM_A.dat.* This file is read in the main MATLAB program.

The coordinates of the GPS satellites and the clock corrections are not given at the same time as we have GPS observations from SWARM, so they need to be interpolated. This is done in the MATLAB file *polint.m*. It uses 11th order Lagrange interpolation for the coordinates, and 3rd order Lagrange interpolation for the clocks. After this you have access to the variables *x_gps_interpolated*, *y_gps_interpolated* and *z_gps_interpolated*, and *clock_correction_interpolated*.

To validate your results you can make use of the precise orbit calculated by Dr. J.A.A. van den IJssel. It is contained in the file *PreciseOrbit_SWARM_A.dat*. Note that you do not need this file for the least-squares estimation itself.

Your report should contain (answers to) the following **(points: 100/100)**
a) Estimate the position of the SWARM satellite for each epoch. At this point you should not yet estimate a clock correction. Show how the length of the vector of residuals for all satellites changes during iteration **(20)**.
b) Show the difference between your solution and the precise orbit direction **(10)**
c) Normally you would estimate a separate clock correction for each epoch. For this question you are asked to estimate **one** receiver clock correction for **all** epochs and show and explain whether the residuals are reduced and whether the accuracy improves **(20)**.
d) Include the light-time effect in your calculations and show and explain whether the residuals are reduced and whether the accuracy improves **(20)**.
e) Mention all error sources that cause the difference between your solution and the precise orbit in d) and order them by importance **(15)**.
f) Assuming you use weighted least-squares. Explain for which measurements you would apply smaller weights **(13)**.

g) Please write in the beginning of your assignment report how many hours you approximately spent on the assignment **(1)**
h) Please include your MATLAB (or other) code as text at the end of the pdf of your report **(1)**