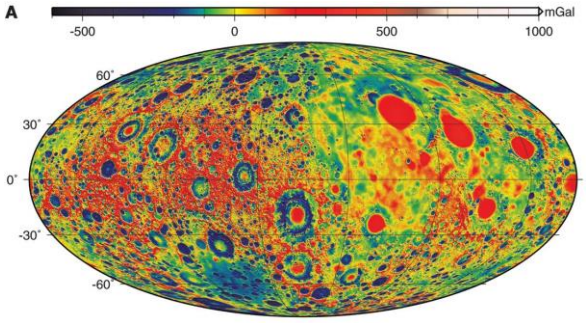
TU Delft **AE4872 (2017) – SATELLITE ORBIT DETERMINATION**

Assignment 3 - Least-Squares estimation of an initial state vector and a dynamic parameter

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



Group Size: 1-2 Students
Due: 13:30h, Monday 9 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.

In the previous assignment you estimated the position of one of the SWARM satellites without taking into account the dynamics. In this assignment the same data is used but now a dynamical parameter is also estimated. Computing analytical or numerical derivatives can get very cumbersome so here only a simple dynamical model is used, and also the numerical integration procedure is rather simple.

In your report show equations in matrix form and give the size of all vectors and matrices and explain what input is needed. Scans of handwritten equations or drawings are allowed. You can also include a commented part of your code in the report. If derivatives are needed, it is sufficient to show the derivation for only one of the x,y, or z components. Lengthy explanations are not necessary.

(points: 100/100)

a) Obtain a least-squares estimate for the initial state vector which consists of position and velocity (6 unknowns). For propagating the state you can use Euler integration with step size equal to the step size between the data points. Use the state transition matrix to relate observations at a certain epoch to the increment of the initial state vector that you estimate. As a first guess for the positions and velocities at the first epoch you may use your results from assignment 2 but change them by a certain amount to make convergence visible. You can use the clock correction from assignment 2. It is not necessary to include the light-time effect in this assignment. Show how many of iterations gives the best result. **(30)**

b) The gravitational potential for a spherically symmetric body is given by equation 2.3 in the lecture notes. Find an estimate for μ by including it in the state vector. Compare your results for the satellite position with the results obtained in b) and with the results you obtained in assignment 2 and comment on the differences. **(25)**

c) Show and discuss the influence of the initial values for the state vector. **(20)**

d) Calculate the standard deviation of the μ parameter. You can assume that the observations are uncorrelated and that they have a standard deviation of 5 m. Explain if the value of the standard deviation is realistic. **(23)**

e) Please write in the beginning of your assignment report how many hours you approximately spent on the assignment **(1)**

f) Please include your MATLAB (or other) code as text at the end of the pdf of your report **(1)**