TTK5 - Kalman Filtering and Navigation

Lab#1 – GNSS: Single Point Position Estimation

Due Date: 10th of October 2017, by 12.00.

Data Description

You will receive a one hour long set recorded by a single L1 frequency GPS receiver. The receiver was stationary during data collection. The data set comes in .mat format. Table 1 describes the data and parameters. Measurement rate for the data is 2 Hz.

Note: the pseudorange measurements in this data set are compensated for the earth rotation, and can be assumed as free for satellite clock error, group delay, relativity effect, and any atmospheric errors.

Table 1: List of the data and parameters included in the data set.

Parameter/Measurement	Units	Name
Time-of-Week: time tag, from the beginning of the GPS week.	seconds	Tow
Pseudoranges (ECEF coordinates)	meters	PR
Satellite positions (ECEF coordinates)	meters	Satpos
True receiver position (ECEF coordinates)	meters	P0
Elevation angle	degrees	EL

Tasks

1. Describe briefly the difference between the global Earth Centered Earth Fixed (ECEF) and local level East North UP (ENU) coordinate frames.

2. Implement single point position estimation using either Weighted Least Squares, or Kalman Filter estimation approach (the choice is yours). If you choose to use Kalman Filter, justify the filter parameters and models you use in your filter. Estimate receiver position using the selected algorithm.

   a) Plot a time series of the position error in East, North and Vertical frame (i.e. error in the local level frame).

   b) Plot a time series of the estimated position standard deviation in the East, North and Vertical frame.

   c) Discuss the difference between the estimated standard deviation and the true error that exists.

3. Calculate and plot Dilution of Precision (DOP) values for the data set including:

   - PDOP,

- GDOP,
- HDOP,
- VDOP, and
- TDOP.

Discuss the observed values and the trend in these measurements.

4. List minimum three technologies/methods that can improve position accuracy of the single point positioning approach.

Report Format

Your final lab report should include a title page with your name, email address and date. You can write it in either Norwegian or English (the choice is yours). Explanation should accompany all plots. Assumptions must be clearly documented and justified. The report is to be submitted by email to: nadia.sokolova@sintef.no .