12.540 Homework #3 **Due Wednesday May 16, 2012.**

GPS Point position estimation

At the end of this message are links to RINEX data files. Using the range data (either C1, P2 (optional) or ionospheric free range) estimate the position of ground station either by least-squares or Kalman filtering. The GPS site is stationary for the first 60 seconds of data (mitb076s.12o) so a single position will represent its coordinates. The range measurements are in meters. Times in the data files are GPS time based on the (non-synchronized) receiver clock. You may assume that broadcast ephemeris is error free and the clock corrections reported by the satellites (af0, af1, af2) are also error free. (Do not forget to account for the light propagation time of the GPS signals).

(1) Compute the difference between the observed pseudorange and theoretically computed ranges using the coordinates in header.
(2) Use the differences between measured and computed pseudoranges for the first 60-seconds of data to obtain a new estimate of the sites coordinates and the time dependent error in the receiver's clock. Explicit estimation of the station clock or a differencing method may be used (or both for those who are want to do it).

OPTIONAL: Use the full data files but the rovr station will move and position estimates at each measurement time should be calculated. The mit0 data is the static nearby base station data set that can be used to do differential positioning as well.

The follow part of the message is RINEX data file. The data portion has the following format:

```
 12  3 16 13 29  7.0000000  0 10G02G07G08G15G29G10G05G21G04G26
 -- GPS TIME of meas.-----  L  #  -- PRN OBS -------- (G Denotes GPS)
```

L is a loss of power flag (should usually be zero except when receiver starts to move).
is the number of satellites, followed by the list of PRN observed.

The layout of the data is given by The TYPES OF OBSERV record in the header
There are 5 observations per line, so in this case with 7 observable types
each data entry takes 2 lines (per satellite observed)

```
     7    L1    L2    C1    P2    P1    S1    S2            # / TYPES OF OBSERV
```

L1 and L2 are the phase measurements (cycles),
C1 is the C/A code pseuodrange measurement (m),
P1 and P2 are P-code range measurements. In this file there are no P1 measurements and the P2 measurements are the C/A code range plus the (P2-P1) range difference obtained by cross correlating the L1 and L2 signals.
S1 and S2 are the signal-to-noise ratios at the two frequencies.

Since these files have 7 observables, the data records spread over two lines per satellite.

```
Data records:
  1392197.68857   1055334.77655  21859392.7424   21859388.8054
        47.7504         34.0004
 -- Data ----FS   -- Data ---FS --- data ---FS  -- data ----FS  -- data ----FS
```

The data are as shown and the FS is a flag (F) and signal to noise ratio on scale 1-10 (S). A value of 1 for means loss of lock and blank or zero means good data (you can ignore these flags in this homework.)
The full definition of the RINEX standard can be found at:
http://igscb.jpl.nasa.gov/igscb/data/format/rinex2.txt

The first 60 seconds of the data is static mitb076s.12o and just this part can be processed if desired.
The broadcast ephemeris to be used is mitb0760.12n

The full MIT0 base station file is mitb0760.12o which can be used for differential positioning of the rover site rovr0760.12o

12.540 Principles of the Global Positioning System

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