

2.2.3 Assignment 1

1. Write a program to convert the ephemerides given in a RINEX navigation file into an ECEF cartesian coordinate system.

- Write a function `read_rinexn` to read the broadcast ephemeris file. This function should return a matrix with 22 rows (the parameters needed later on in the calculations) and as many columns as there are ephemerides. You will need the 17 following parameters, I suggest you use the variable names of the first column:

<code>svprn</code>	satellite PRN number
<code>Mo</code>	mean anomaly, radians $[\mu_0]$
<code>roota</code>	\sqrt{a} (semi-major axis), \sqrt{m} $[\sqrt{a}]$
<code>deltan</code>	variation of mean angular velocity, radians/s $[\Delta n]$
<code>ecc</code>	eccentricity $[e]$
<code>omega0</code>	argument of perigee, radians $[\omega_0]$
<code>cuc, cus, crc, crs, cic, cis</code>	correction coefficients, m or radians
<code>i0</code>	inclination, radians $[i_0]$
<code>idot</code>	rate of inclination, radians/s $[\dot{i}]$
<code>Omega0</code>	right ascension, radians $[\Omega_0]$
<code>Omegadot</code>	rate of right ascension, radians/s $[\dot{\Omega}]$
<code>toe</code>	time of ephemeris, seconds of the current GPS week $[t_{oe}]$

The call to that function could look like: `eph = read_rinexn(eph_file)`

Important note: `trans` is the transmission time of the message (in seconds of the current GPS week). This parameter is not used in the satellite position calculation, but should be close to t_{oe} . If it is negative (it happens!), then the whole data block should be discarded.

- Write a function to convert the ephemerides matrix (output of previous function) for a given satellite at a given time (i.e. 3 input arguments). This function should return the corresponding X,Y,Z coordinates in ECEF frame, for instance:

`[X,Y,Z] = get_satpos(t,sv,eph).`

A possible algorithm is given below, together with the formulas that give the values for $\Omega, \omega, i, E, r, v$ needed in the equations below:

- (a) Extract needed parameters from the GPS broadcast ephemerides file. Note that the RINEX navigation files provide information every 2 hours only. In other words, Keplerian elements and their corrections are updated by the ground control segment