Homework2 Coordinate Conversion

- Coordinate conversion: find a point A on SJTU campus, marked on the Baidu/Google Map to obtain the geodetic coordinate(l,l,h), and convert it to ECEF, and ECI (optional).
- Given a point B (121.455899°, 31.036321°，100m), calculate the ENU of point B relative to your own Point A. Plot the skymap marked with elevation and azimuth.

LLA to ECEF

given latitude ϕ, longitude λ, height h;

$$
\begin{aligned}
X &= (N(\phi)+h)\cos\phi\cos\lambda \\
Y &= (N(\phi)+h)\cos\phi\sin\lambda \\
Z &= ((1-e^2)N(\phi)+h)\sin\phi
\end{aligned}
$$

where

$$
N(\phi) = \frac{a}{\sqrt{1-e^2\sin^2\phi}}
$$

set $A(31.036, 121.455, 0)$, the coordinate in `ECEF` is
$(-2.8437*10^6, 4.66613*10^6, 3.26931*10^6)$

ENU

- get the `ECEF` position of point A
- get the `ECEF` position of point B
- using transferring matrix

the vector in `ENU` coordinate from `r` to `p` is:

$$
\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -\sin\lambda_r & \cos\lambda_r & 0 \\ -\sin\phi_r\cos\lambda_r & -\sin\phi_r\sin\lambda_r & \cos\phi_r \\ \cos\phi_r\cos\lambda_r & \cos\phi_r\sin\lambda_r & \sin\phi_r \end{bmatrix} \begin{bmatrix} X_p - X_r \\ Y_p - Y_r \\ Z_p - Z_r \end{bmatrix}
$$

so the vector $r \to p$ will be the vector in sky map.