Exercise on 11.12.2019

Task 1 *(2 Points)*

Show that $\Omega_{ie}^{e} \cdot \Omega_{ie}^{e} \cdot x^{e}$ corresponds to the centripetal acceleration

$$a_z = \omega_E^2 \cdot r$$

where r is the distance to the rotation axis and ω_E is the angular velocity of the earth.

Task 2 *(3 Points)*

The pilot of a parking aircraft reads off the following values of the axis of the IMU:

$$\begin{aligned} a_1^p &= -0.5\,\mathrm{m\,s^{-2}} \\ a_2^p &= 0.6\,\mathrm{m\,s^{-2}} \\ \omega_{i,p1}^p &= 4.6035 \times 10^{-5}\,\mathrm{s^{-1}} \\ \omega_{i,p2}^p &= -8.1172 \times 10^{-6}\,\mathrm{s^{-1}} \end{aligned}$$

Calculate R, P, Y (Roll, Pitch and Yaw) of the platform. Additionally calculate the standard deviation of the heading angles under the assumption that the standard deviation of the IMU is $s_{a_1^p} = s_{a_2^p} = 0.003\,\mathrm{m\,s^{-2}}$ and $s_{\omega_{i,p1}^p} = s_{\omega_{i,p2}^p} = 3.0 \times 10^{-8}\,\mathrm{s^{-1}}$ and uncorrelated.

Task 3 *(5 Points)*

Calculate the matrices Ω_{ie}^{n} for local level coordinate systems (**n**-systems), which are at the following positions:

i) Longitude 13° 17′ 34.187″
   Latitude 0° 0′ 0.000″
   Height 50.00 m

ii) Longitude 17° 17′ 24.356″
   Latitude 47° 21′ 26.483″
   Height 125.13 m

iii) Longitude 12° 13′ 12.156″
   Latitude 90° 0′ 0.000″
   Height 50.00 m

Use $\omega_E = 7.292\,115\,816 \times 10^{-5}\,\mathrm{rad\,s^{-1}}$. Discuss the results.