Exercise on 20.11.2019

Task 1 *(5 points)*

Given are the following combinations of three consecutive rotations around the three axes:

$$\alpha_1 = 0.3°,\ \beta_1 = 0.2°,\ \gamma_1 = 0.05° \tag{1}$$

$$\alpha_2 = -30°,\ \beta_2 = 35°,\ \gamma_2 = -20° \tag{2}$$

i) Calculate the DCMs following equation (2.4) and (2.6) from the lecture (different rotation conventions)

ii) Derive the corresponding Euler Symmetric Parameters from the DCMs

Task 2 *(5 points)*

In the lecture has been shown (equation (3.12)), that the time derivative of the transformation-matrix $\dot{\boldsymbol{C}}_t^s$ can be expressed using the equation

$$\dot{\boldsymbol{C}}_t^s = \boldsymbol{C}_t^s \cdot \boldsymbol{\Omega}_{st}^t,$$

where $\boldsymbol{\Omega}_{st}^t$ is the matrix representation of the angular velocity vector $\boldsymbol{\omega}_{st}^t$. In the derivation the linearisation of small Euler Angles was utilized by the use of the limit $\Delta t \to 0$. This equation could also have been achieved by strict differentiation of $\boldsymbol{C}_t^s = \boldsymbol{C}(1, \alpha) \cdot \boldsymbol{C}(2, \beta) \cdot \boldsymbol{C}(3, \gamma)$.
Show analytically, that eq. (3.12) holds, using the simplification that only rotations around the first axis are taken into account:

$$\boldsymbol{C}_t^s = \boldsymbol{C}(1, \alpha), \qquad \alpha = \omega_1 \cdot t, \qquad \boldsymbol{\omega}_{ts}^t = \begin{bmatrix} \omega_1 \\ 0 \\ 0 \end{bmatrix}$$