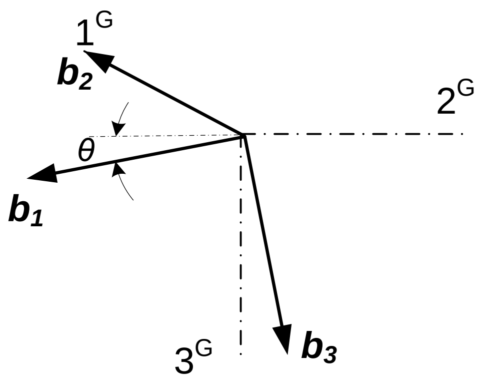
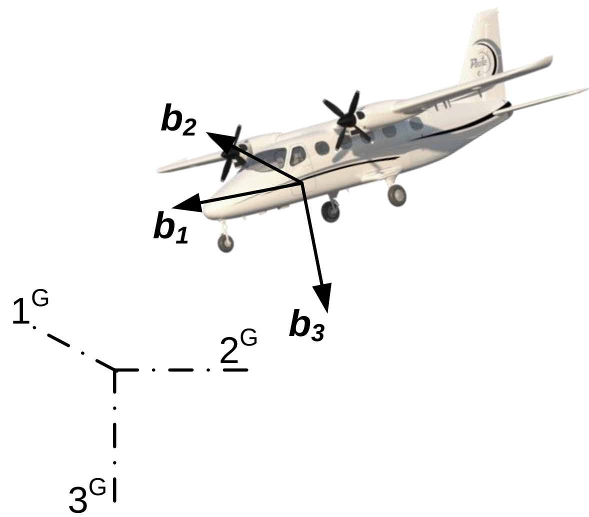
Assignments

Modeling Flight Dynamics with Tensors

Lecture 3

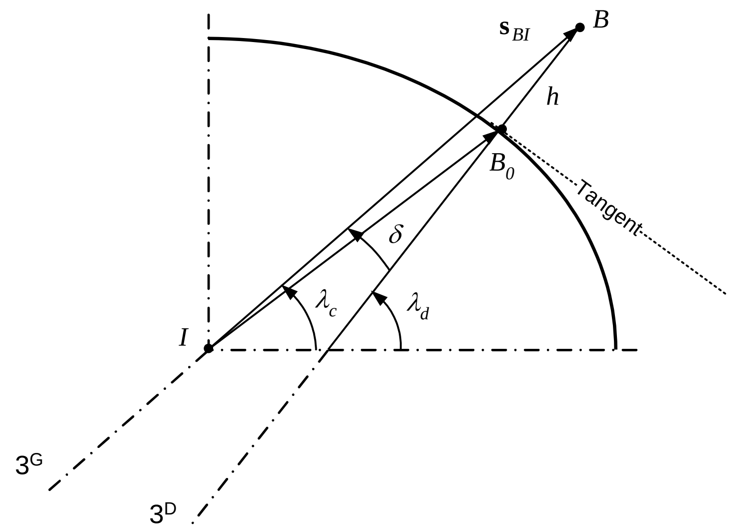
Problem 1 Transformation Matrix





Let's use the example of Lecture 2 again of the aircraft approaching the runway. Now you are to determine the transformation matrix between the aircraft's body coordinates wrt the geographic coordinates $[T]^{BG}$ using the relationship of Slide 9 of the transformation matrix consisting of base row vectors. The aircraft's base vector $\boldsymbol{b_1}$ is tilted down by θ = 10 *deg* wrt to the horizon. (The aircraft's body axes $]^B$ are the preferred coordinate axes, overlaying its base triad $\boldsymbol{b_1}$, $\boldsymbol{b_2}$, $\boldsymbol{b_3}$.)

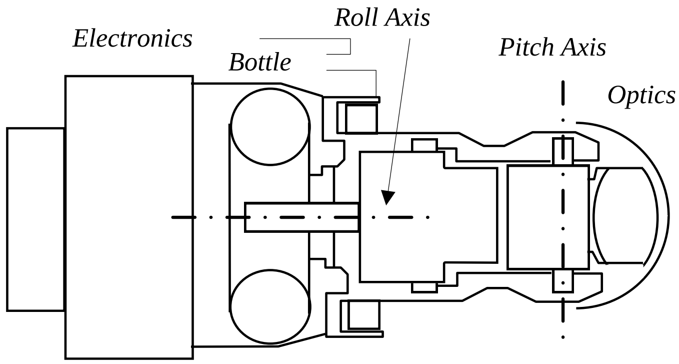
Problem 2 Geodetic Coordinates

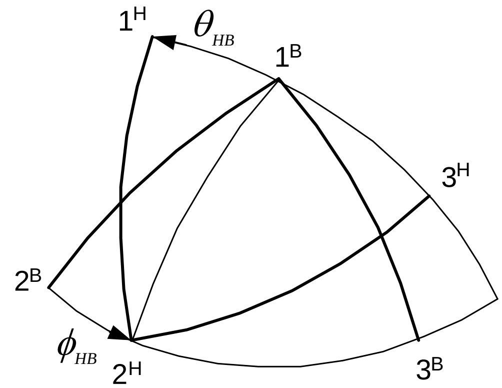


With Slide 13 I introduced you to the *geocentric* coordinate system $]^G$, which is used when the Earth is modeled as a sphere. In this case the 3^G axis goes through the center of the earth. However, a more accurate Earth model is a spheroid. Here the vertical projection of point ***B*** onto the Earth's surface does not project through the center of the Earth. This axis is labeled 3^D with *D* standing for geo**d**etic, and the *geocentric* latitude λ_c is renamed *geodetic* latitude λ_d*.*

You are to derive the transformation matrix $[T]^{DG}$ with the deflection angle $\delta = \lambda_d - \lambda_g$ using the *pattern-scheme of transformation matrices* explained in the lecture.

Problem 3 IR Seeker Gimbal Transformation





A typical IR sensor has two gimbal axes: *roll* and *pitch*. The roll axis allows the optics to be turned relative to the missile body, followed by the pitch axis. The outer roll gimbal angle is ϕ_{HB} and the inner pitch gimbal angle θ_{HB} .

Determine the transformation matrix $[T]^{HB}$ based on the orange peel diagram on the right side.