

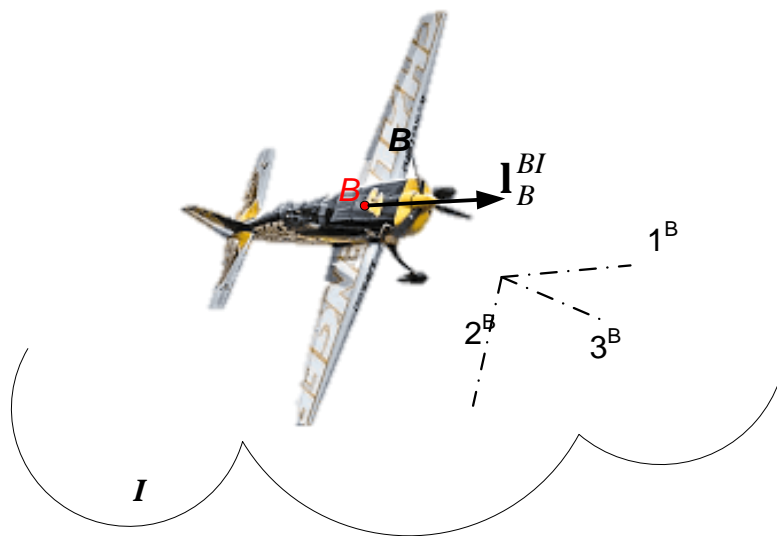
Assignments

Modeling Flight Dynamics with Tensors

Lecture 9

Problem 1 Gyroscopic Moment of Aircraft Engine

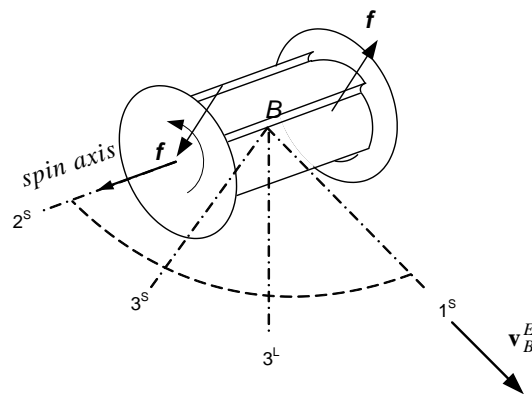
Aircraft B makes a vertical pull up at angular velocity ω with its propeller having an angular momentum I . The propeller acts like a gyro, which will give rise to a moment about the 1^3 axis. To counteract the momentum the pilot has to deflect the rudder. Which pedal will he have to press?



Problem 2 Nutation of Magnus Rotor

A Magnus Rotor is an autorotating shape, spinning about its 2^S axis, which uses the Magnus lift effect to glide to the ground with velocity \mathbf{v}_B^E . I investigated these Magnus rotors for my dissertation. To determine the nutational damping effect, two explosive charges were fired during descent, creating the force couple $\mathbf{f}-\mathbf{f}$, which induced a nutation. From cinetheodolite tracking data the nutational damping was then derived.

Compute the initial value of the nutation angle θ . The numerical values are $m_B = 2 \text{ Nm}$, $\Delta t = 0.5 \text{ sec}$, $I = 0.0268 \text{ kg m}^2$, $\omega = 1000 \text{ RPM}$.



Problem 3 Energy Theorem Derivation

Slide 7 states the *energy theorem* $\frac{dT^{BI}}{dt} = \overline{\boldsymbol{\omega}}^{BI} \mathbf{m}_B$, i.e., how the external moment changes the kinetic energy. Derive the theorem starting with the rotary part of the previous equation..