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AER408
Aerospace Guidance & Control Systems

Task (1)
Autopilot Literature Review

Research questions

In this task you are asked to find out:

a) "What is an Autopilot?", i.e. define its main objective
b) What are the inputs & outputs of Autopilot system onboard an airplane?
c) What would be the role of the pilot in an airplane equipped with an autopilot?
d) What is the difference between Autopilot & SAS?
e) What is the role of the onboard sensors like (GPS, gyroscopes, ..etc)? give example.

Flight Mechanics review

Review the Airplane equations of motion (EOM) in 3D space & the stability analysis of conventional airplanes and answer the following

a) State the general rigid body dynamics (RBD) equations in 3D space
b) Classify the upper equations into (Kinetics & Kinematics) equations
c) What are the assumptions introduced while deriving those equations?
d) State the set of equations added to the (RBD) equations to form the Fixed wing Airplanes (EOM)
e) Classify the airplanes EOM equations mathematically.
f) What is the difference between the (Body axes) and the (earth or inertial axes)?
g) What is the difference between the pitch angle (θ) and the angle of attack (α), and between the sideslip angle (β) and the heading angle (ψ)?

Numerical solution of ODEs

Based on your studies about the numerical solution of ordinary differential equations in **MTH316A** course and on the mathematical classification of the Airplane's EOM

a) State some of the numerical solving algorithms for ODEs
b) Choose one algorithm for solving the Airplanes EOM, clearly state the (Initial conditions needed, Inputs needed in each iteration, and Outputs calculated in each iteration)
c) Solve the system of first-order ODEs:

$$\frac{dy_1}{dt} = \sin(t) + \cos(y_1) + \sin(y_2)$$

$$\frac{dy_2}{dt} = \cos(t) + \sin(y_2)$$

The Initial conditions are:

$$at\ t = 0\ , \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

End of solution interval:

$$t = 20$$

Number of intervals:

$$n = 100$$

Do not solve by hand, build a code or use excel sheet. You should validate your results against any other source like the (ode45) MATLAB function.