Flight Mechanics: Homework 2

Asst. Prof. Barış Başpınar

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Policy

You should write your own answer/code by yourself. Cheating is highly discouraged for it could mean a zero or negative grade from the homework. If a question is not clear, please let us know via email.

Submission Instructions

Please submit your homework through the Ninova website. Please zip and upload all your files using filename *studentID.rar*. You must provide all functions you wrote with your zipped file. Functions you do not submit will cause you to lose a portion of your grade. Please make sure that you comment on your code. Make also sure that the plots you produce are readable and they have labels and legends.
You **MUST** include the *report.pdf* file with your homework. Include there:

1. answers to the questions,
2. outputs for each question,
3. how to call your functions for each question.

Problems

In this homework, you are expected to implement basic airline procedure, propulsive and fuel consumption models. Aircraft performance parameters to be used are in aircraft.OPF file. The required formulas and the structure of .OPF file are available in BADA 3.11 user manual.

Speed Schedules

Using BADA3.11 user manual and aircraft.OPF file, solve the problems given below.

(a) Assume ISA conditions ($\Delta T = 0$) and use expression to calculate Mach/CAS transition altitude as a function of Mach and CAS. Write a Matlab function ($f(Mach, CAS)$) that gives the Mach/CAS transition altitude. Plot the $H_{trans} - Mach - CAS$ 3D graph for $Mach \in [0.25, 0.35]$ and $V_{CAS} \in [90, 150]kt$.

(b) Airline procedure model corresponds to calculation of the nominal speed schedule in application for different flight phases. Write Matlab functions that calculate nominal speeds for a given altitude for climb, cruise and descent. In calculations, take the standard calibrated airspeeds as $V_{cl,1} = 98kt$, $V_{cl,2} = 93kt$, $M_{cl} = 0.2$, $V_{cr,1} = 155kt$, $V_{cr,2} = 150kt$, $M_{cr} = 0.28$, $V_{des,1} = 178kt$, $V_{des,2} = 178kt$ and $M_{des} = 0.38$. Plot the $H - V_{nominal}$ graphs for climb, cruise and descent phases for $H \in [0, 17500ft]$. (see Section 4 in BADA3.11 user manual)

Propulsive Forces

Using BADA3.11 user manual and aircraft.OPF file, solve the problems given below.

(a) Assume that geopotential pressure altitude (H_p) equals to geopotential altitude (H) and assume ISA conditions ($\Delta T = 0$). Then, calculate maximum climb and take-off thrust according to altitude. Write a Matlab function ($f(H)$) that gives the maximum climb and take-off thrust. Plot the $H - T_{climb}$ graph for climb phase for $H \in [0, 17500ft]$.

(b) Calculate descent thrust according to altitude. Write a Matlab function ($f(H)$) that gives the descent thrust. Take the $H_{p,des} = 8000ft$ and only use $C_{Tdes,high}$ and $C_{Tdes,low}$ in calculation. Plot the $H - T_{descent}$ graph for descent phase for $H \in [0, 17500ft]$.

Fuel Consumption

Calculate fuel consumption according to altitude for climb, cruise and descent phases. Write Matlab functions ($f(H)$) that give the fuel consumption for climb, cruise and descent phases. Plot the $H - f$ graphs for climb, cruise and descent phases for $H \in [0, 17500ft]$.

Note: Be careful some calculations depend on the engine type.
Note 2: Use functions in problem 1.b to calculate the V_{TAS} if the speed is required for calculating the thrust or fuel consumption.