Assignment 4: Air Transportation Systems Analysis

Due: February 24, 2023 Instructor: Trani

Problem 1

Use the new generation twin-engine transport aircraft to answer this question (http://128.173.204.63/cee5614/cee5614_pub/B787_class.m).

a) Estimate the aircraft rate of climb after departing New York Kennedy International airport while the aircraft **flies at 350 meters above sea level and 220 knots indicated**. Assume atmospheric conditions are ISA. Assume the wing **flaps are fully retracted** and use the regular table lookup function to estimate *Cdo* provided in the aircraft file. The aircraft departs New York with a mass of 215,000 kilograms.

b) Estimate the rate of climb after departing New York Kennedy International airport while the aircraft flies at **350 meters above sea level conditions and 220 knots indicated airspeed and with one engine failed** (assume one engine fails just as the aircraft climbs through **350 meters above** sea level conditions). Assume the **wing flaps are fully retracted** and use the regular table lookup function to estimate Cdo provided in the aircraft file. The aircraft departs New York with a mass of 215,000 kilograms.

c) Compare the rates of climb obtained in parts (a-b). Comment on the implications if the aircraft looses an engine at 350 meters.

Problem 2

Use the new generation twin-engine transport aircraft to answer this question (http://128.173.204.63/cee5614/cee5614_pub/B787_class.m). This problem is a continuation of Problem 1. The aircraft departs New York with a mass of 215,000 kilograms.

a) Run the **unrestricted climb Matlab code** demonstrated in class for the aircraft in question. Simulate the climb profile for 3600 seconds (one hour) and estimate the **time to climb** and distance traveled to reach FL 330 (33,000 feet). The aircraft departs JFK at ISA conditions.

b) Using the results obtained in part (a), estimate the fuel burned during the climb to reach FL 330.

c) On the return flight from Mumbai, the **temperature conditions are ISA + 26 deg. C**. Mumbai is at sea level conditions. Run the computer simulation (similar to part a) using the same initial takeoff mass of 215,000 kilograms and estimate the time to climb, distance traveled, and fuel used to reach FL330. Compare the results obtained in parts (a-c) and comment on the effect of temperature on rate of climb and time to climb.

d) Another day, the flight departs Denver International Airport at 200,000 kilograms and ISA + 15 deg. C conditions. Find the **initial cruise altitude** selected by the pilot if the crew wants to have a 500 ft/minute climb rate capability at the initial cruise altitude. Normally, pilots want to have a small climb rate margin for maneuvering at altitude.

Problem 3

The new generation twin-engine transport aircraft to answer this question (http://128.173.204.63/cee5614/cee5614_pub/B787_class.m).

a) Estimate the value of Specific Air Range (SAR) for the aircraft after reaching the Top of Climb (TOC) point at 35,000 feet and with a mass of 205,000 kilograms. The aircraft cruises at Mach 0.83.

b) Use the Range equation, to estimate the maximum range for the aircraft if the aircraft reaches the TOC point (35,000 feet) at 205,000 kilograms. The aircraft cruises at Mach 0.83. The pilot estimates the aircraft carries 90,000 kilograms of fuel remaining at the TOC point. In the range calculation, assume the range is calculated using the aircraft mass at the mid-point between TOC and TOD. Also, assume that 6500 kilograms of fuel are needed in the descent plus a possible diversion to an alternate airport.

c) Solve the problem in part (b) using a piecewise numerical analysis method (as explained class). Use the range value obtained in part (b) and refine the answer obtained by dividing the range into six segments in the numerical solution. Comment on the obtained in parts (b) and (c).