Assignment 4: Air Transportation Systems Analysis

Due: October 3, 2018 Instructor: Trani

Problem 1

Use the large, twin-engine transport aircraft to answer this question (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing777_class_2006.m).

a) Estimate the rate of climb after the aircraft departs Chicago O'Hare International Airport (ORD) at a point 150 meters above the airport ground level. Assume the aircraft has takeoff flaps of 10 degrees which adds 0.010 to the draft coefficient. The aircraft departs ORD airport with a mass of 320,000 kilograms. The indicated airspeed at the point of interest is 190 knots.

b) Repeat the process now simulating an engine failure at the same point as in part (a) in the climb profile. Compare the rates of climb obtained in parts (a) and (b).

c) Will the aircraft be able to clear a 1,200 meter obstacle (above ground level) located 6.3 nm from the point of engine failure? The minimum clearance vertical distance to an obstacle is 300 meters.

Problem 2

Use the large, twin-engine transport aircraft to answer this question (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing777_class_2006.m)).

a) Estimate the value of Specific Air Range (SAR) when the aircraft is in the initial cruise phase at 10,000 meters and with a mass of 310,000 kilograms. The aircraft cruises at Mach 0.83 (true Mach Number).

b) Use the Range equation, to estimate the maximum cruise range for the aircraft if the aircraft reaches the TOC point (10,000 meters) at 310,000 kilograms. The aircraft cruises at Mach 0.83. The pilot estimates the aircraft carries 125,000 kilograms of fuel remaining at the TOC point.

c) Solve the problem in part (b) using a piecewise numerical simulation method (as explained class). Use the range value obtained in part (b) and refine the answer obtained by dividing the range into 8 segments or more in the numerical solution. Comment on the obtained in parts (b) and (c).

d) Find the optimal cruise Mach number for the aircraft cruising at 10,000 meters for the conditions stated in part (b).

e) Find the thrust needed to keep the aircraft in a coordinated turn (at constant altitude) at 5,000 meters while flying at 290 knots indicated airspeed. The aircraft mass is 260,000 kilograms. Assume a standard turn maneuver.

f) Find the distance and fuel burn consumed in a 4-minute holding pattern flown at 5,000 meters and 290 knots (see graphic). The holding pattern is flown 2 minutes turning and two minutes in straight and level flight. The aircraft mass is 260,000 kilograms as the aircraft enters the holding pattern.

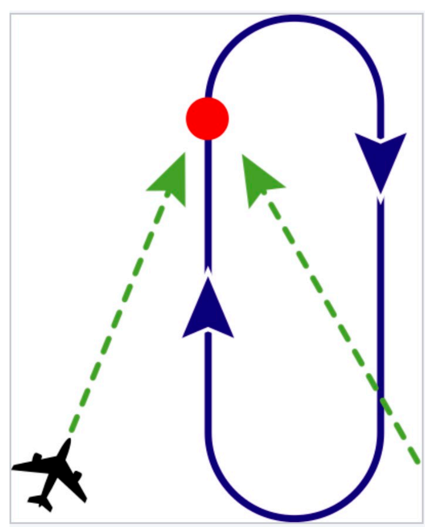

Figure 1. Standard Holding Pattern (Wikipedia).