

Assignment 5: Air Transportation Systems Analysis

Date Due: October 7, 2015 via Email

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Problem 1

On a busy day, Chicago O'Hare Terminal Radar Approach Control (TRACON) instructs a few aircraft to fly holding patterns over Lake Michigan. The typical holding pattern is flown as a 4-minute maneuver with one minute per side and one minute in the 180-degree turns (see Figure 1). On a busy day, the controller instructs a pilot flying a long-range wide-body aircraft (like the Boeing 787 class vehicle provided in the class notes) to fly the pattern at 12,000 feet and 240 knots (IAS).

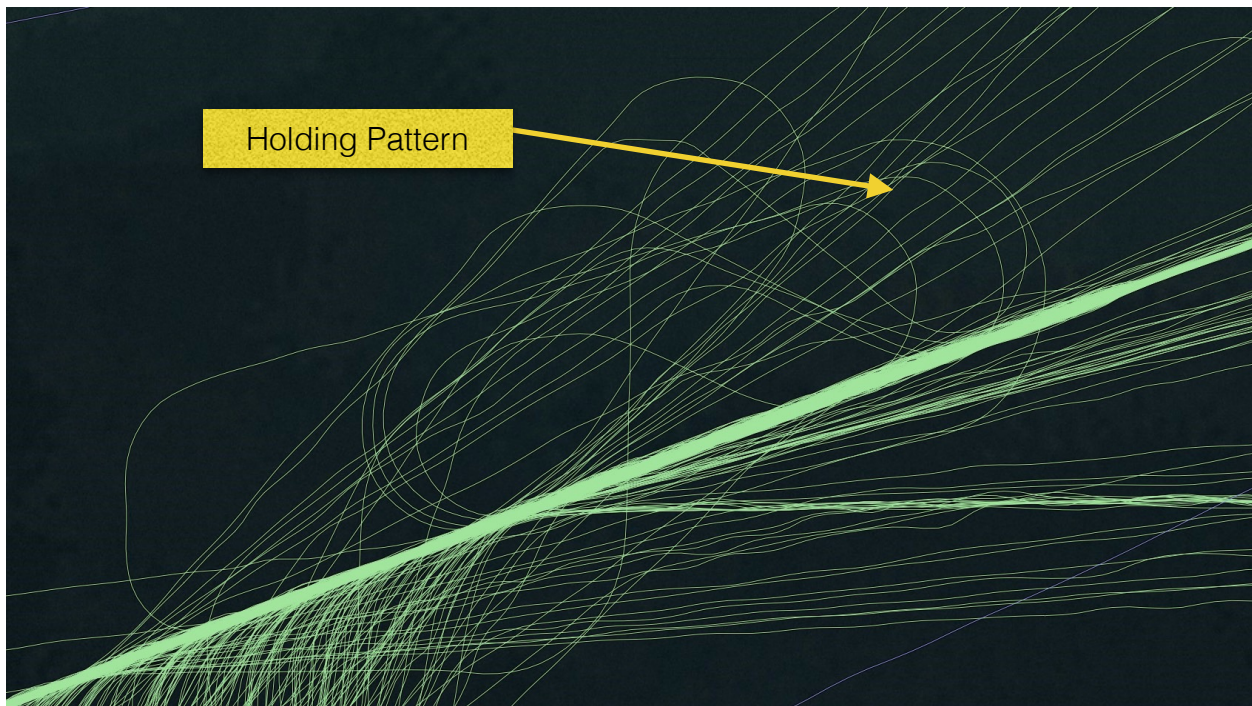


Figure 1. Holding Patterns over Lake Michigan.

- Estimate the fuel burn consumed in one 4-minute holding pattern for the aircraft in question.
- Estimate the how much engine thrust is needed in both the straight and the turning segments of the holding pattern.
- Find the radius of the turn for the aircraft flying the holding pattern.
- What is the bank angle (in degrees) to fly the holding pattern?

Problem 2

Read Chapter 1 of the Instrument Procedures Handbook (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/instrument_procedures_handbook/). Briefly answer the following:

- a) How many types of departure Procedures exist? In two sentences explain each one.
- b) Explain the difference between actual and Net Flight Paths. Refer to Figure 1-19 in the Handbook.
- c) Define what is required navigation performance (RNP).
- d) What is the typical RNP in the enroute and terminal airspace today in the NAS?

Problem 3

To do this problem, use the Boeing 737800 class aircraft file from the web site (http://128.173.204.63/courses/cee5614/cee5614_pub/Boeing737800Jet_class.m).

- a) Use the `unrestrictedClimbAnalysis.m` Matlab script to estimate the mass of the aircraft at the Top of Climb (TOC) point. The aircraft takeoff weight is 76,000 kg. with 20,000 kg of fuel. Use the default climb speed profile provided in the aircraft data file. Use ISA atmospheric conditions in your calculations. The departure airport is located at sea level conditions. Select the TOC altitude so that the aircraft has an initial 500 ft/min climb capability.
- b) Use the `unrestrictedDescendAnalysis.m` Matlab script to estimate the fuel used from the Top of Descent (TOD) point (say at 33,000 feet) to the destination airport. The destination airport is located at sea level conditions (assume ISA conditions in the decent as well). In this calculation assume the mass at the TOD point is 60,000 kg.
- c) Use the Breguet range equation, find the still-air (no wind) range of the aircraft with the parameters provided in parts (a) and (b) with the aircraft flying at 33,000 feet and Mach 0.78. To calculate the range parameter use the mass of the aircraft at a mid-point between TOC and TOD points.