Quiz 2 (Open Book/Notes)

Date Due: Wednesday November 20, 2013

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Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

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Problem #1 (50 points)

The North Atlantic Organized System (OTS) is typically made up of 6 Eastbound Track as shown in Figure 1. Each track is delineated by waypoints spaced every 10 degrees of longitude as shown in Figure 1. The OTS track configuration shown in Figure 1, has 6 tracks with an average track length of 1,700 nm. Canadian controllers "meter" (or space) traffic at the blue circles to enforce correct procedural separation.

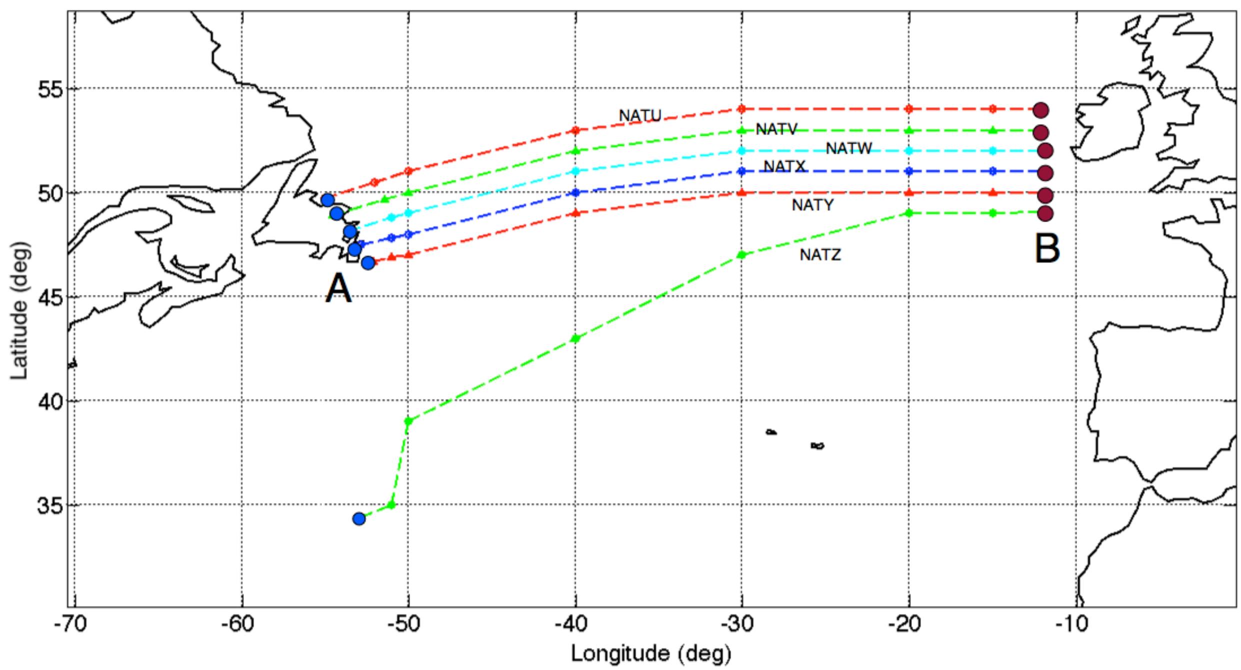

Figure 1. NATS OTS Track System (Eastbound).

a) Use the time-space technique described in class to derive saturation capacity two simple mathematical headway separation rules used by Oceanic controllers if the aircraft traveling at the same speed on the same track and cruise flight level are separated by a **nominal headway** of 10 minutes plus ATC buffers. The headway or time between successive arrivals to the NAT track system needs to be adjusted to account for "closing" or "opening" conditions considering pairwise flight operations (i.e., a lead and a following aircraft). For example, an air traffic controller in Canada (entry point for Eastbound flights) adjusts the entrance of a "following" aircraft into a track and cruise flight level if the "lead" aircraft is slower so that both aircraft will have a **nominal headway** condition (10 minutes) as the "leader" crosses the red dots (point B in Figure 1) near the European side. On the other hand,If the lead aircraft is faster than the following aircraft, the minimum separation between the two aircraft is enforced at the NAT OTS entry point (off Canadian Coast) is 5 minutes. ATC Oceanic controllers apply normally distributed buffers with a standard deviation of the delivery accuracy of 20 seconds. Oceanic controllers are more risk avert than their terminal area counterparts and tolerate 1% probability of violation between two successive operations. Inside the OTS track system pilots are required to fly at constant mach number in the .

b) Using the rules proposed in part(a), **estimate the saturation capacity of track NATX** (see Figure 1) if the arrival distribution of flight arrivals is random to the NAT entry point and if the fleet mix using the track is shown in Table 1. In your analysis consider that each NAT OTS tracks includes all cruise flight levels between 320 to 390 (inclusive).

Table 1. Aircraft Population Operating in the North Atlantic Organized System.

Aircraft Group	Typical Cruise Mach Number	Percent Mix (%)
B757, B737, Airbus 320	0.79	15
B767, A330, A340	0.81	30
B747,A380	0.84	25
B777, B772ER	0.83	30

c) The introduction of DataLink Communications (called CPDLC) and Future Area Navigation Systems (FANS 1/A1) onboard aircraft is expected to change the North Atlantic procedures described in part (a). For example, controllers handling aircraft equipped with both CPDLC and FANS 1/A1 will be able to use Reduced Longitudinal Separation Minima Procedures (RLongSM) so that nominal headways will be reduced to 5 minutes (from 10 minutes today). Using the new technology, **estimate the saturation capacity of track NATX** (see Figure 1) if the arrival distribution of flight arrivals is random and if the fleet mix is still as shown in Table 1. Contrast the saturation capacities obtained in parts (b) and (c).

Problem 2 (50 Points)

For the aircraft climb and maneuvering example solved in class (http://128.173.204.63/courses/cee5614/cee5614_pub/aircraft_maneuvering_performance.pdf), find the maximum takeoff weight for the very large capacity aircraft to legally depart the airport and clear the 1,500 meter hill by 300 meters. Assume the flap setting is at 10 degrees. Also assume the aircraft fully retracts the landing gear at 50 meters of altitude and the climb speed is 190 knots (Indicated) in the initial climb for the first 6 miles after engine failure. The aircraft has 3 remaining engines after point A.

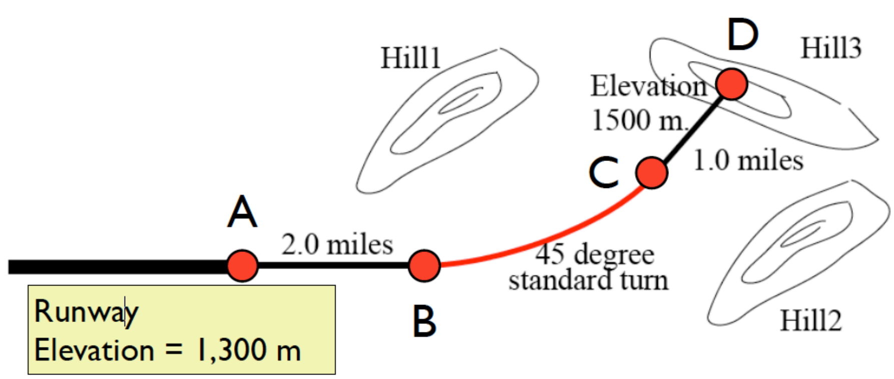

Figure 2. Engine Out Procedure for Problem 2.