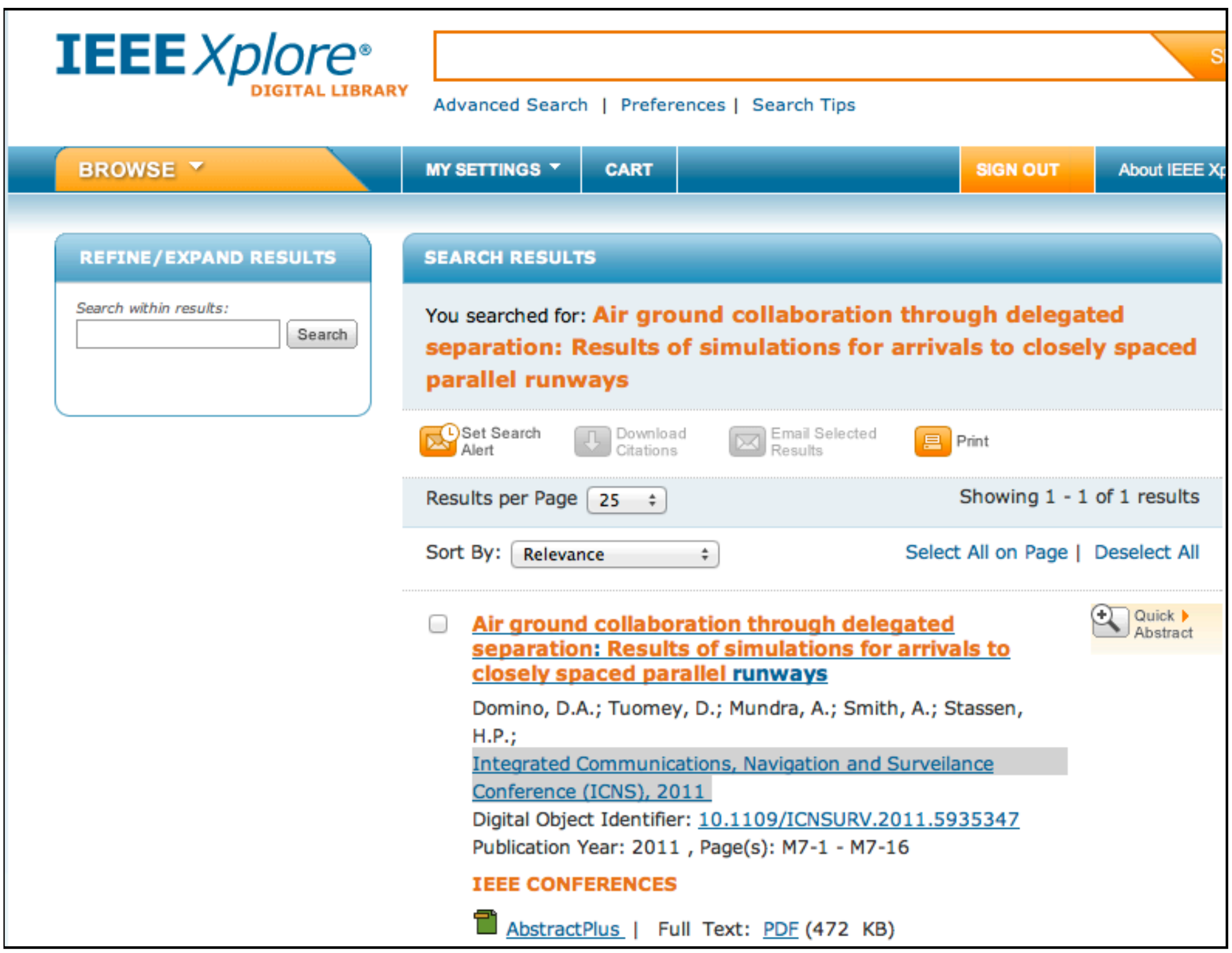
Assignment 5: Capacity Analysis

Date Due: November 9, 2011 Instructor: Trani

Problem 1

Read the technical paper entitled “Air ground collaboration through delegated separation: Results of simulations for arrivals to closely spaced parallel runways” by Domino, D.A.; Tuomey, D.; Mundra, A.; Smith, A.; Stassen, H.P.; and make a summary of the points stated in the paper in two pages (doubled spaced). This article appeared in the Integrated Communications, Navigation and Surveillance Conference (ICNS), 2011. State some of the challenges to conduct parallel approaches to closely parallel runways. You can obtain the article by logging in to the VT library (see figure below).



Problem 2

Use Google Earth to help you answer the following question.

a) Read about the SOIA approaches at SFO and state the benefits and weather conditions that force this airport to use such approaches. I suggest you read the media document http://www.flysfo.com/web/export/sites/default/download/about/news/pressres/ref/pdf/weatherops.pdf before others.

b) Using the NAS_Operations file provided, filter the arrival and departure operations to SFO. Plot the number departures per hour and arrivals per hour as a function of time (i.e., for a 24-hour period). Recall that all times provided in the FAA ETMS data are UTC times (London time) and need to be converted to local SFO times (SFO time is -8 hours from London).

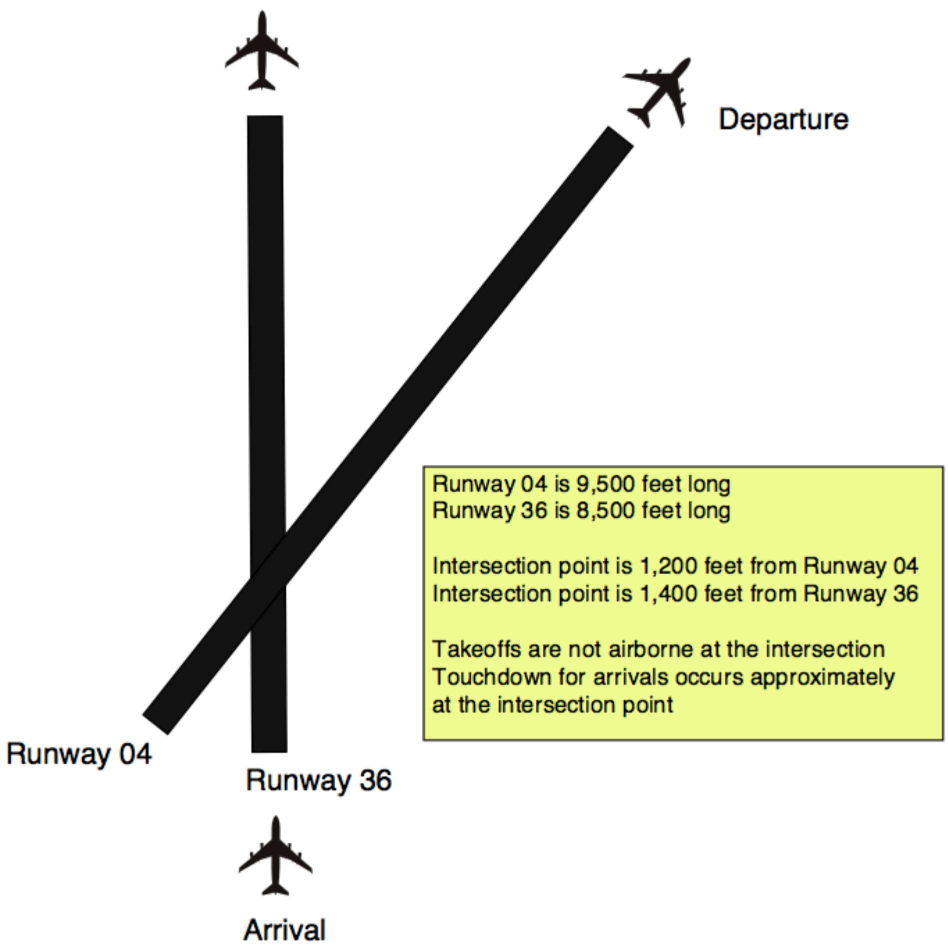
c) In the same plot draw horizontal lines representing the restricted IMC and PRM/SOIA (marginal weather) capacities. Comment on the demand vs capacity at the airport under IMC and marginal weather conditions.

d) Using the IMC runway arrival capacity for arrivals found in part (b) and using a deterministic queueing model (D/D/1) estimate the average delays to aircraft arrivals at SFO.

e) Repeat (d) for marginal weather conditions. Comment on the benefit of the PRM/SOIA approach procedure.

Problem 3

You are expected to perform a capacity analysis for the airport shown in Figure 1. The airport has a standard airport surveillance radar (ASR) which tracks aircraft up to 60 miles form the airport site. The radar has a scan rate of 4 seconds. Tables 1 and 2 show the typical ATC separations at the airport under IMC conditions. Assume the minimum separations under VMC conditions are reduced by 10% from those observed under IMC conditions. The airport has the following technical parameters: a) in-trail delivery error of 15 seconds (because there is a radar at the site), b) departure-arrival separation for both VMC and IMC conditions is 2 nautical miles, c) probability of violation is 5%. Arriving aircraft are “vectored” by ATC to the final approach fix located 8 miles from the runway threshold. Arrivals follow in-trail after crossing the final approach fix. The airport aircraft mix, runway occupancy times and approach speeds are shown in Figure 1. the IMC separation matrices are shown in Tables 1 and 2.



	Small	Large	B757	Heavy	Superheavy
ROT (s)	48	51	60	65	75
Percent Mix (%)	10	55	10	20	5
Vapproach (knots)	120	142	145	155	155

Figure 1. Airport Arrival and Departure Operational Procedures for Problem 1.

Table 1. Minimum arrival-arrival separations under IMC conditions. Values in are nautical miles. Values Shown Do Not Include Buffers.

Minimum Separation Matrix (nm)		Arrivals-Arrivals			
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	2.5	2.5	2.5	2.5	2.5
Large	4	3	2.5	2.5	2.5
B757	5	4	3	3	2.5
Heavy	6	5	4	4	4
Superheavy	10	10	10	10	10

Table 2. Minimum departure-departure separations under IMC conditions. Values in are seconds.

Departure-Departure Separation Matrix (seconds)					
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	60	60	60	60	60
Large	90	60	60	60	60
B757	120	120	60	60	60
Heavy	120	120	120	120	90
Superheavy	150	120	120	120	120

a) Calculate the arrival-departure saturation capacity diagram (Pareto diagram) under IMC conditions (show all your work). Because of the shorter runway 36, no super-heavies and heavies are allowed to takeoff on runway 36. Runway 04 is used by all classes of aircraft. In your analysis, assume all aircraft, irrespective of their wake class, accelerate at an average of 2.5 m/s^2 on takeoff roll.

b) Suppose that under new NextGen operations, the in-trail delivery error is reduced to 5 seconds and the common approach path is reduced to 5 nm. Find the benefit to arrival capacity of the airport. Comment on may happen to the departure saturation capacity of the airport.