

SCT Trajectory & Separation Optimization

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Objective

- Enable Continuous Descent Approaches to all airports in the Southern California TRACON by:
 - Determining trade-off between throughput, noise, emissions and fuel burn as a function of initiation altitude and stringency of waypoint altitude crossing restrictions
 - Setting initiation altitude, initial separation and stringency of waypoint altitude crossing restrictions to meet desired throughput for each runway

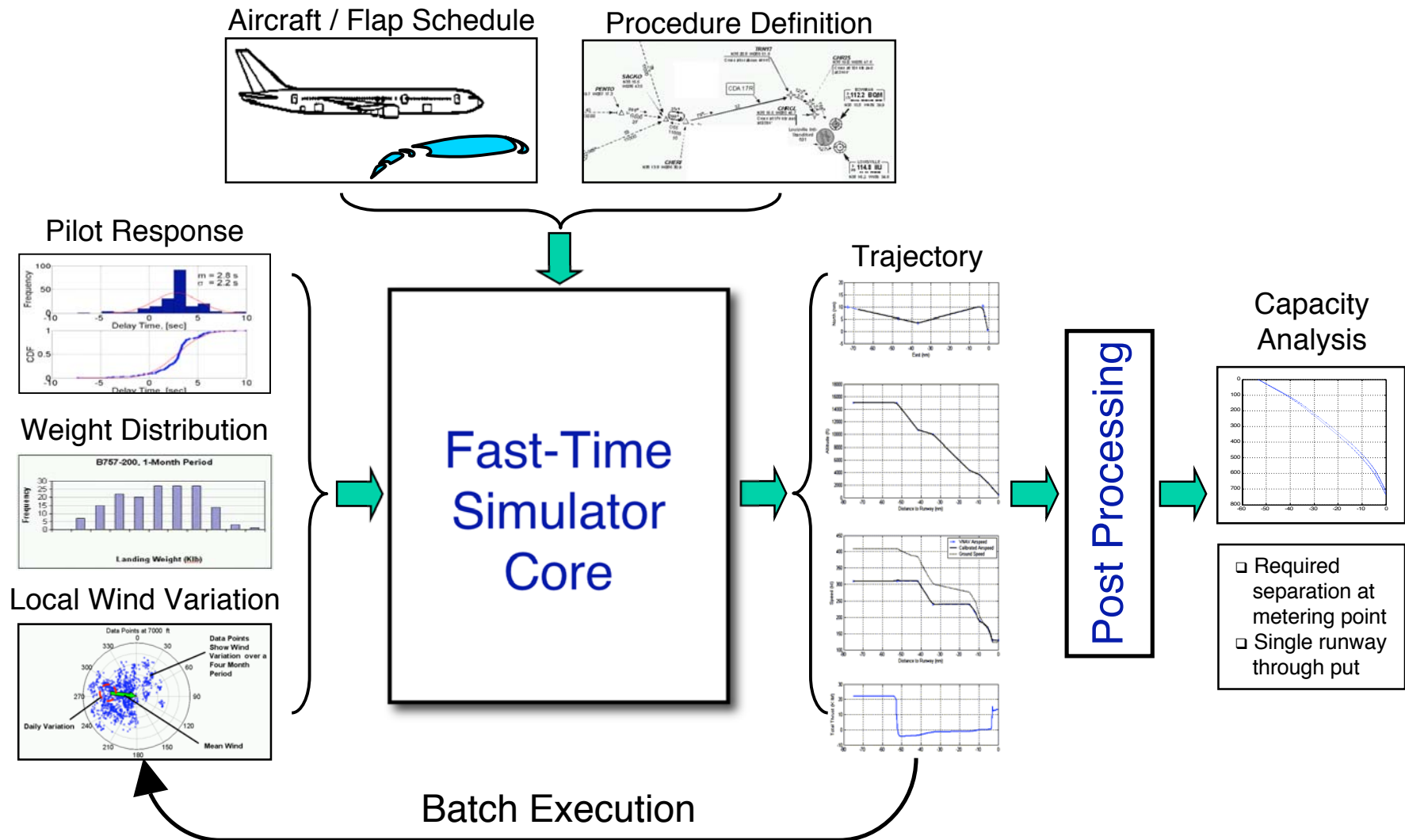
Research Approach

- For a given lateral profile
 - Determine range of crossing altitudes (at each waypoint) for each aircraft type in unrestricted descent using Monte-Carlo simulation tool
 - Develop set of scenarios with different initial altitudes and waypoint altitude crossing restrictions
 - Determine required initial separation and throughput for each scenario using Monte-Carlo simulation tool
 - Determine fuel burn, emission and noise impact for each scenario
 - Establish trade-off between throughput, noise, emissions and fuel burn as a function of initiation altitude and stringency of waypoint altitude crossing restrictions

Monte Carlo Simulation

- Flight path is computed as a function of time...
 - Lateral position
 - Altitude
 - Speed
 - Thrust setting
 - Speed brake setting
 - Flap setting
 - Landing gear position
- Given uncertainties in...
 - Pilot behaviour
 - Aircraft weight
 - Wind

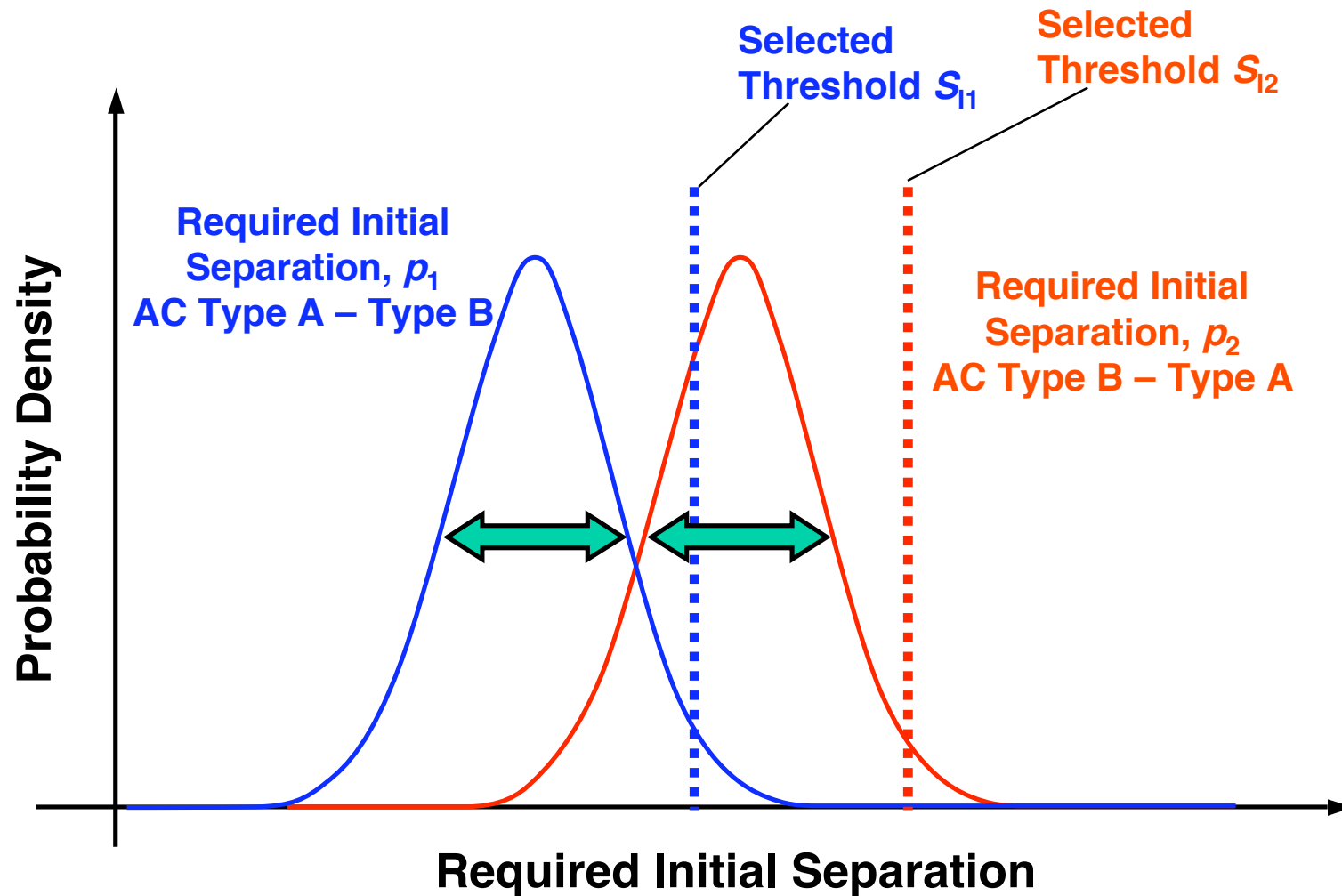
Monte Carlo Simulation



Monte Carlo Simulation

- No interaction between consecutive flights
 - Each flight simulated separately
 - Controller intervention not simulated (contingency)
- Wind variations handled through convolution
 - Leading flights
 - An ensemble of flights simulated with wind fixed to the nominal wind condition while retaining other factors such as pilot response and weight as random
 - Trailing flights
 - Another ensemble of flights simulated with wind that is equal to the nominal wind condition plus inter-flight wind variation, in addition to random factors such as pilot response and weight
 - Flights from leading ensemble and trailing ensemble convoluted to form probability density functions

Separation Analysis Methodology



CIVET Arrival

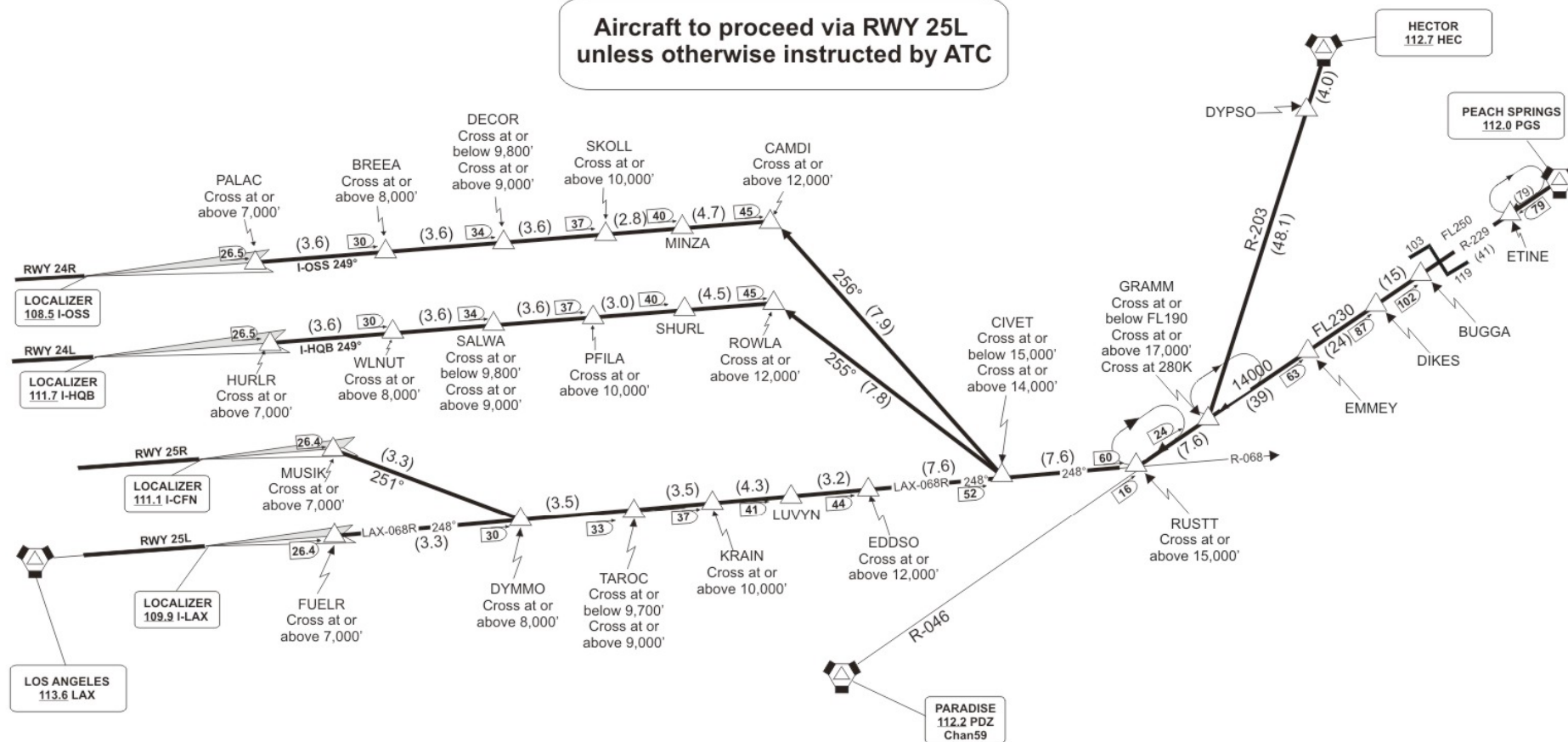
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CIVET FIVE ARRIVAL

8/8/2005

**Aircraft to proceed via RWY 25L
unless otherwise instructed by ATC**

NOTE: DME or RADAR required.
NOTE: Chart not to scale.



CIVET Altitude Analysis

- Initiation point assumed to be GRAMM where the control handoff takes place
- Mean wind and wind variation calculated using ACARS data from LAX arrivals
 - Eastern Portion of the Airport (for Civet Arrival Path)
 - Wind divided into “bins” of 20 knots depending on the strength of the wind the direction of the runway
 - Winds tested range from -110 to +110

CIVET Altitude Analysis

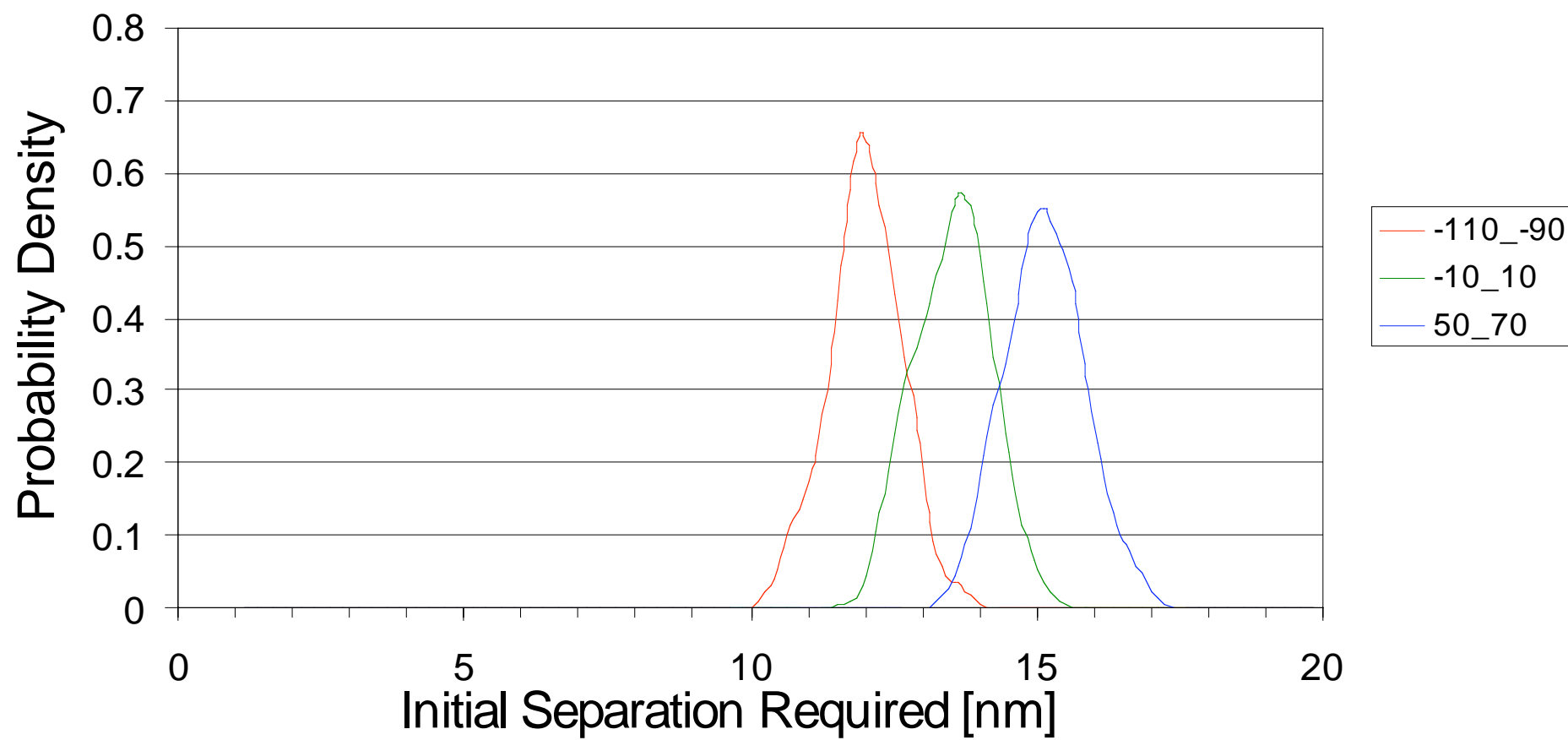
With Mean Wind of Zero

		HIGH[ft]	LOW[ft]
B737	GRAMM	20850	19311
	EDDSO	11813	11382
	DYMMO	8262	8164
B747	GRAMM	20485	19216
	EDDSO	11795	11378
	DYMMO	8570	8406
B767	GRAMM	18799	17601
	EDDSO	10965	10732
	DYMMO	8180	8020

CIVET Separation Analysis

- 100 leading flights and 100 trailing flights simulated for each aircraft type
- Aircraft descent simulated from cruise altitude
 - No level segment at the initiation altitude
- Initial separation values dependent on:
 - Leading aircraft type and weight
 - Trailing aircraft type and weight
 - Mean wind and wind variation
 - Pilot response

767 Leading 747



Status/Future SCT-PARTNER

- Analysis procedure up and running
- CIVET and SEAVU analysis near complete
 - LAX wind model for wide range of days and hours
 - Altitude and separation analysis to be completed for wider range of aircraft types
- Passive test of “TMA type implementation” in FY06
- Other runways/airports to be taken in rank order (based on needs of Walter et al.)