



## **CDA Procedures at SDF**

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## Background

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- **MIT led team conducted the successful and widely publicized flight test of a Continuous Descent Approach (CDA) procedure at Louisville International Airport (SDF) in 2002.**
  - Two B767-300 aircraft at the tail end of the UPS arrival bank were selected each night for the test.
    - First aircraft flew a conventional approach.
    - Second aircraft flew the CDA approach.
  - Lateral path were the same for both.
    - Enabling direct comparison of noise impact.
  - Flight test conducted during two-week period beginning on 29 October 2002.



## Key Findings of 2002 Flight Test

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### □ **Significant benefits:**

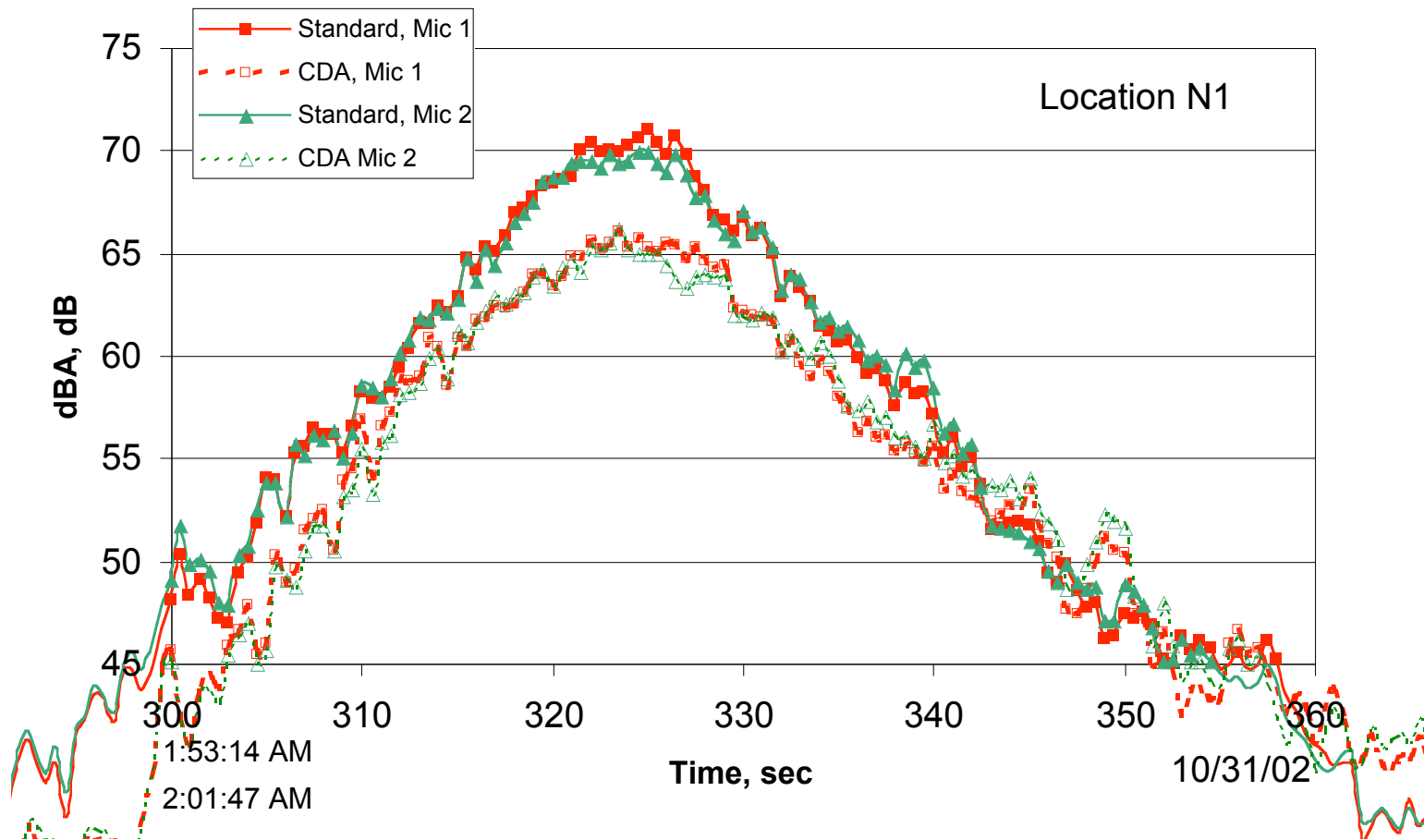
- 4 to 6 dB peak noise reduction in Floyds Knobs, IN;
- 500 lb. per aircraft fuel burn reduction;
- 100 sec. Flight time reduction.

### □ **Flight Management System (FMS) issues can cause undesirable auto-throttle and auto-pilot behavior:**

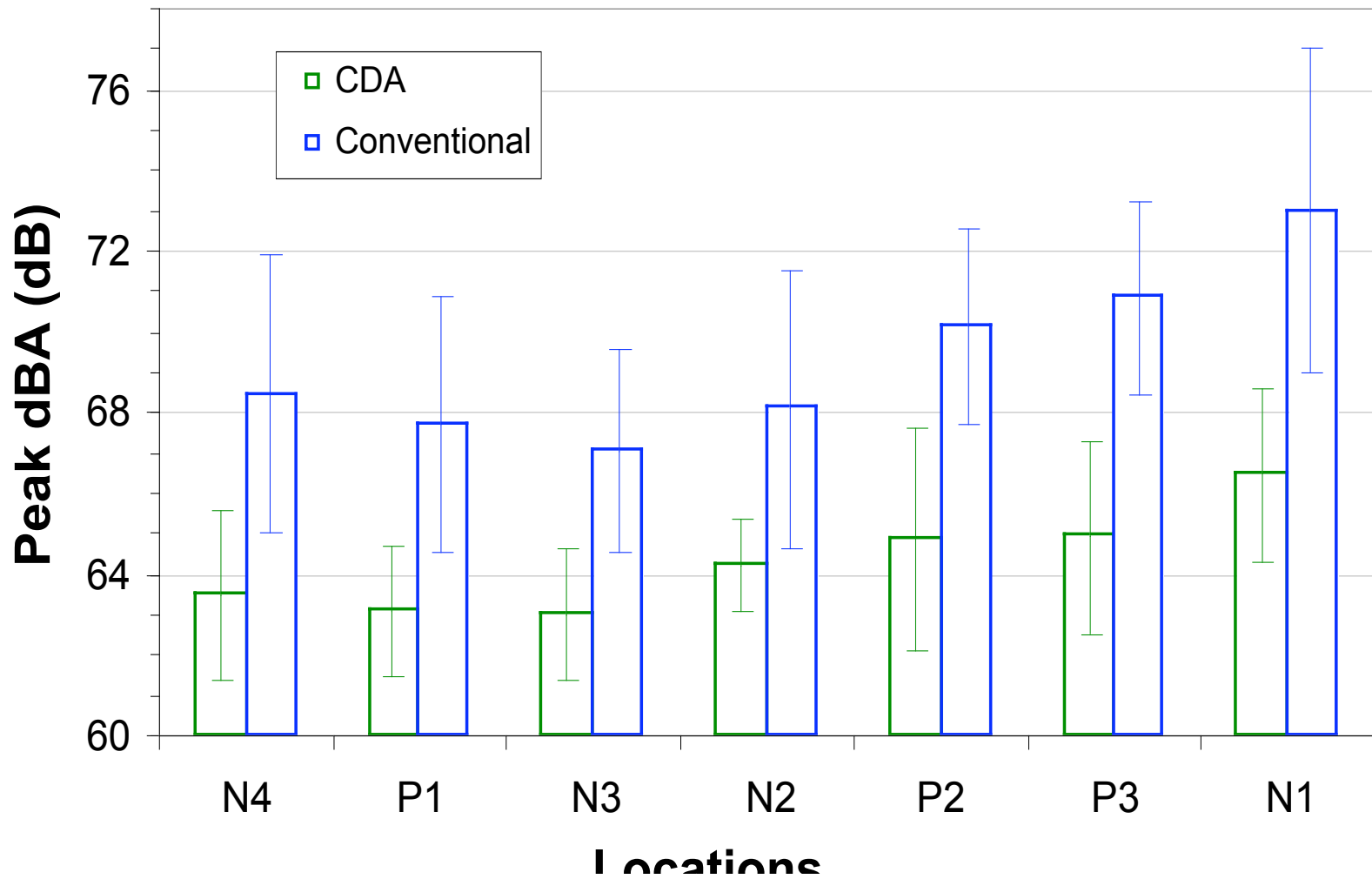
- Auto-throttle engages (with high thrust) if pilots are tardy in extending flaps/gear or if unexpected wind caused aircraft to slow more quickly than expected;
- Auto-pilot decreasing descent rate to arrest acceleration thus taking aircraft off desired path.



# Noise Reduction



## Noise Reduction (2)





## Goals for Current CDA Flight Test

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- **Design RNAV CDA procedures for runway 17R and 35L that:**
  - Eliminate FMS issues identified in 2002 flight test;
  - Begin at a higher altitude thus providing more fuel burn and emissions benefits;
  - May be used in daily operation.
  
- **Conduct flight test with greater number of aircraft (up to 20) each night to:**
  - Demonstrate consistency of procedure in terms of aircraft performance and noise benefits;
  - Provide data required for operational acceptance.



# Team

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## □ Primary Participants:

- MIT (lead)
- Boeing
- FAA
- NASA
- RAA
- UPS

## □ Secondary Participants:

- Rannoch
- DOT Volpe Center
- Wyle Labs



# Research Approach

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- **Determine waypoints and corresponding crossing restrictions and pilot procedures:**
  - Analytical analysis;
  - Simulator studies (at Boeing, NASA and UPS);
  - Beta flight tests (conducted by management pilots).
  
- **Determine initial separation required to ensure that the minimum separation is never violated:**
  - Monte-Carlo simulation (at MIT).



## Research Approach (2)

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### **□ Develop controller procedures:**

- Determine procedures that give pilots sufficient flexibility but maintain ability of controller to monitor and intervene if necessary.

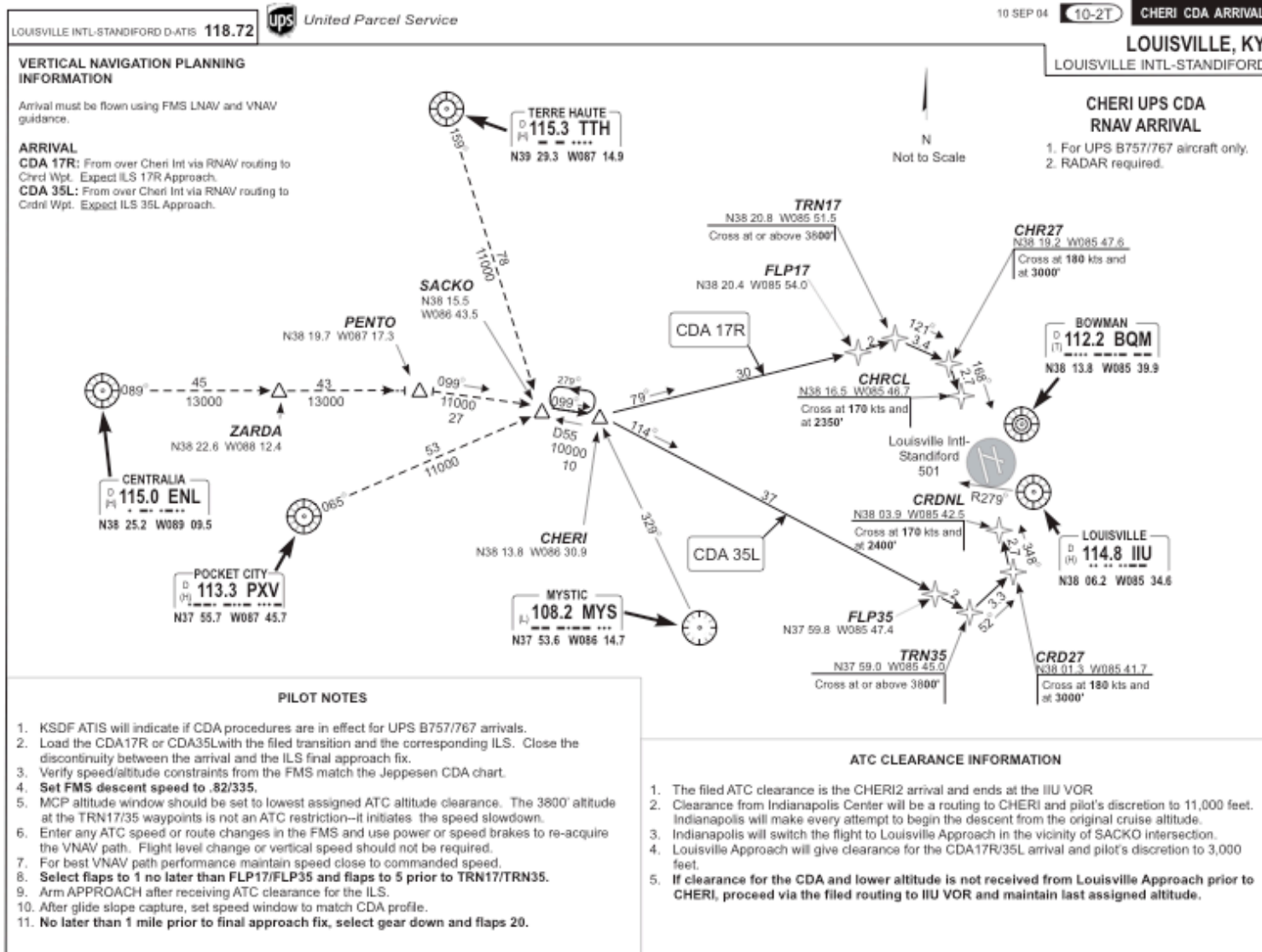
### **□ Develop noise monitoring plans:**

- Determine locations for noise monitoring stations.

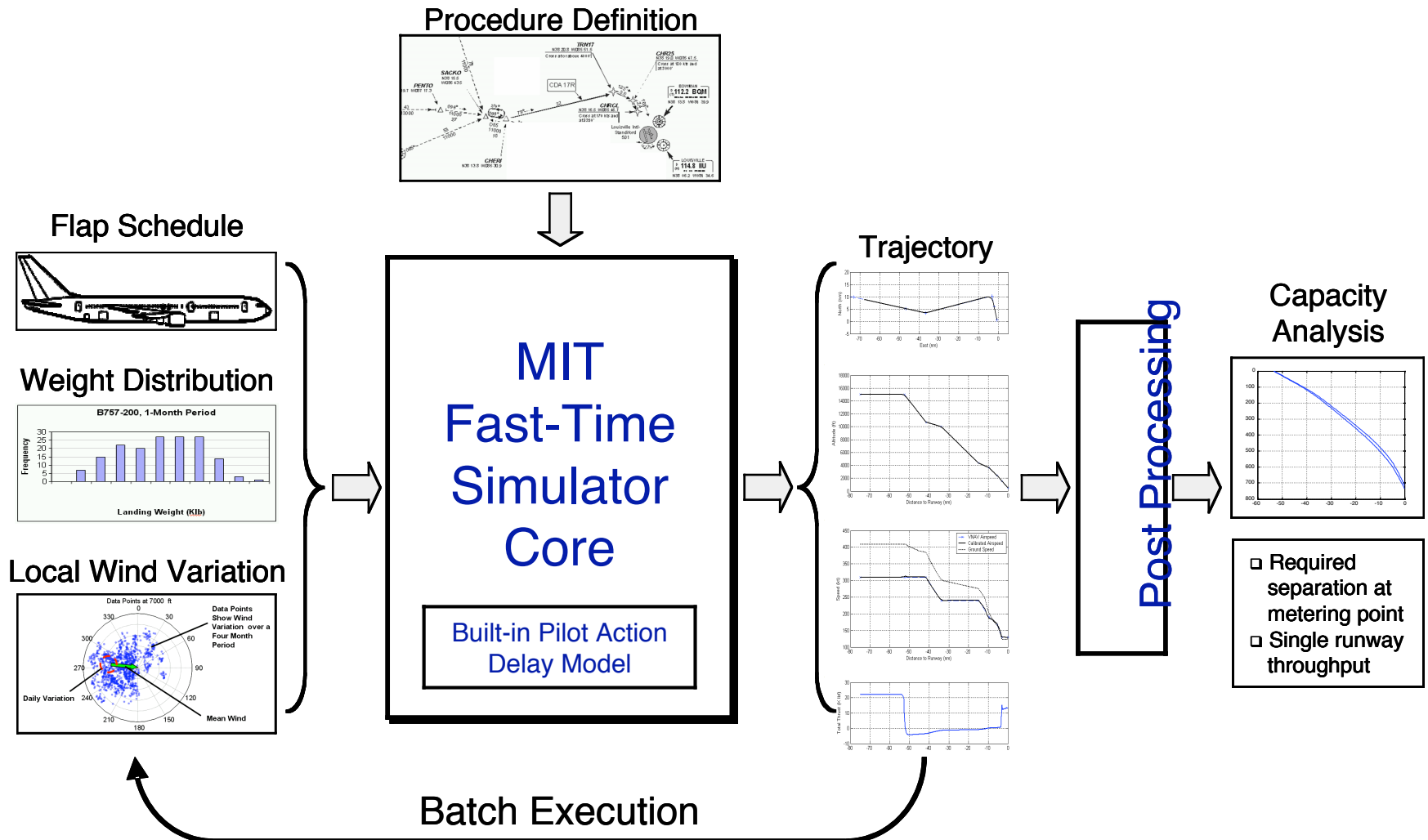
### **□ Conduct flight test between September 13 and September 26.**



# Approach Chart



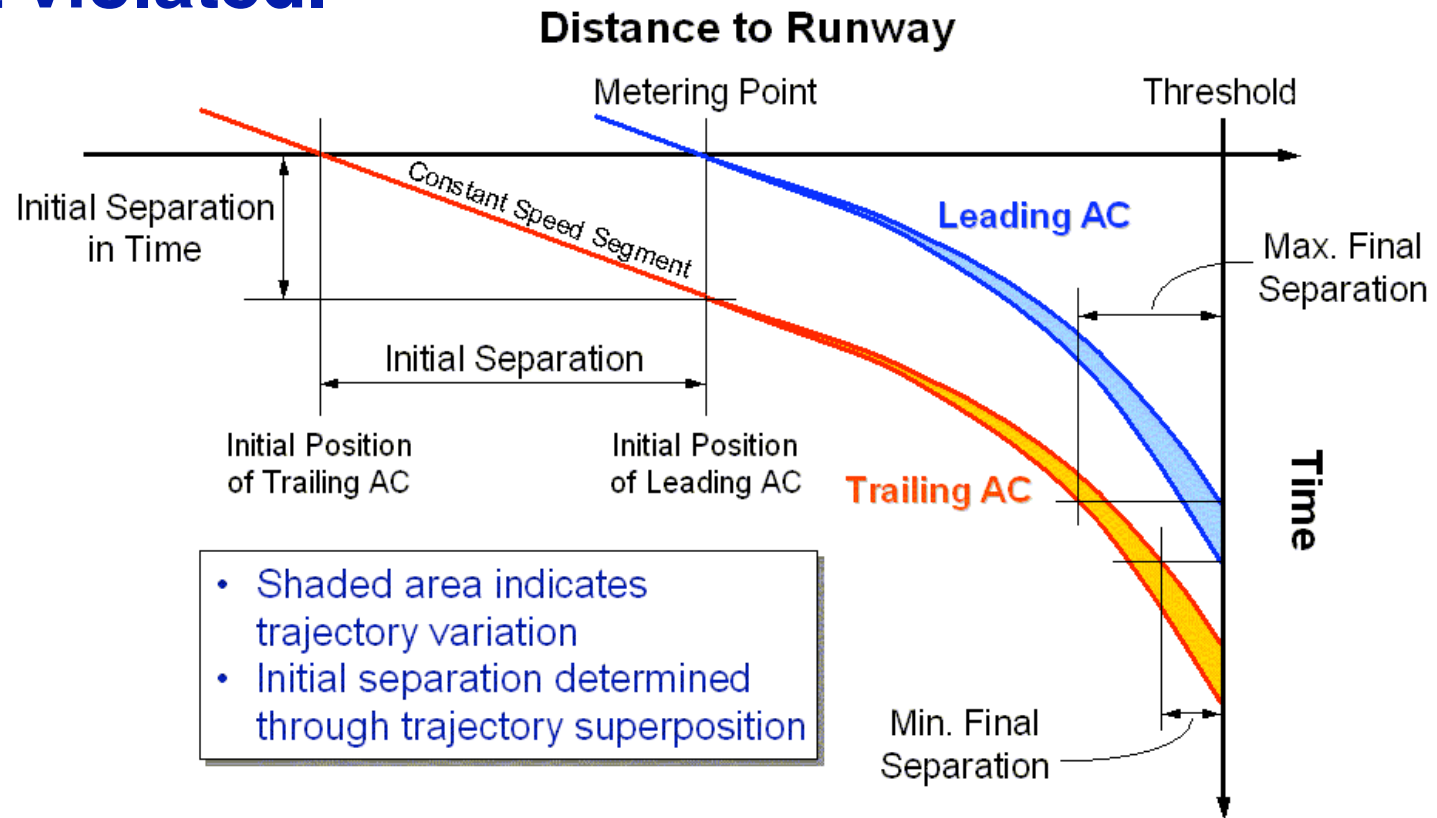
# Fast-time Monte Carlo Simulation



Source: Liling Ren (Graduate Student)

# Airport Capacity Analysis

- **Determine runway throughput by determining required separation at metering point to ensure that separation minima are not violated.**





# Status

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## □ **Flight test successfully completed:**

- 126 aircraft planned over 10-nights
  - 123 aircraft performed as expected
  - 2 aircraft were adjusted (due to lower initial separation)
  - 1 captain declined to participate
- Noise data collected on 9 of the 10 nights;
  - Late switch in direction of operation prevented noise measurement team moving to other side of airport.
- CDA and non-CDA aircraft successfully mixed on one night.

## □ **Data analysis underway**

- Report should be completed by November 30.



## Goals for Next Phase of Research

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### **□ Provide criteria for implementation of CDA throughout the National Airspace System:**

- Many airports are interested in implementing CDA;
- Guidelines required for establishing priority and developing airport specific procedures.

### **□ Implement CDA at night where beneficial:**

- Permanent procedure at SDF will be first to go through 18-step FAA approval process.

### **□ Develop controller tools for implementation in higher traffic scenarios:**

- Design and test systems to help controllers estimate initial separation and future state of CDA aircraft.