Air Traffic Management using SimEvents®

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Outline

- Problem Background
- Discrete Event Simulation
- Modeling Approach
- Demo: Air Traffic Management with SimEvents
- Speeding up large-scale air traffic simulations
Problem Background
Modeling and Simulation Methodologies

Trajectory-Based Simulation
Used for:
- Trajectory Prediction
- Trajectory Optimization
- Conflict Detection/Resolution
- Weather Re-routing

Discrete Event Simulation
Used for:
- Traffic Flow Management
- Optimal Flight Scheduling
- Runway/Airspace Balancing
- Impact of Bad Weather
Discrete Event Simulation

- Discrete-Event Simulation (DES) provides an efficient way to model event-based systems

- DES Simulations may be used to:
  - Model movement of entities
  - Capture queuing and transport delays

- SimEvents adds DES to Simulink®

In This Demo
- Entities = Airplane flight
- Events = Landing / Take Off / Transition
- Attributes = Qualities / Take Off Time / Airspeed
Workflow

- Flights
  - Path and Times
- Airports
  - # Runways
  - Runway Service Time
- Departures
  - Schedule

- Create SimEvents Model
  - Graphically (drag & drop)
  - Programmatically

- Inspect Network Performance
  - SimEvents Scopes
  - Save Data To MAT files
  - Process in MATLAB
  - Objective function for
    Optimization

MATLAB Pre-Processing

SimEvents

MATLAB Post-Processing

Run(1) = pass
Run(2) = fail
Run(3) = pass
Pre-Processing in MATLAB

- **Flights**
  - To / From airport **Attribute**
  - Departure time **Event**
  - Sequence through centers **Attribute**
  - Time spent in each center **Attribute**

- **Airports**
  - # Runways **Parameter**
  - Runway Service time **Parameter**

- **Departures**
  - List of entity (flights) generation times **Event**

- **Centers**
  - Capacity **Parameter**
SimEvents Custom Library Blocks

Operator

Generator

Center

Airport

FromRouter

ToOperator

NumAC

FromOperator

AirportOutputData

AirportName
Star-Configured Modeling  
(Operator Centric)

- Center 1
- Center 2
- Center 3
- Center 4
- Airport A
- Airport B

Processing Time
- Transition
- Weather Delay
- Queuing Delay

Processing Time
- Approach
- Descent
- Runways
- Taxi
- Etc…
Star-Configured Model
Sample Results

SimEvents Signal Scopes

MATLAB post-processing
SimEvents Demo
Scaling Up and Simulation Speed

- Increase # Centers -> 20+
- Increase # Airports -> 200+
- Use real ARTCC structure

- Use real 48 state USA map
- Determine actual flight paths
- Build model programmatically
MATLAB Pre-Processing

SimEvents

MATLAB Post-Processing

MATLAB Batch-Process Loop

for i = 1:10
    run simulation with params(i)
end

Real-Time Workshop

“model.exe”

Save Files

Build and Compile

Run(1) = pass
Run(2) = fail
Run(3) = pass
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