Spot and Runway Departure Advisor (SARDA)

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September 16, 2013
Topography of Airport and Surface Management

Surface traffic management complicated by:
- Uncertainties
- Lack of common situational awareness and coordination
- First-come, first served operations

- 8 major airports – over $2B of excess fuel consumption over 2010 – 2030
- JFK – 15,000 hours of taxi delays per year
- BOS – 6,570 hours of taxi delays per year
Intelligent Scheduling is the Key to Efficient Surface Management

SARDA is the NASA’s approach for solving this problem.

• Optimizes at a system level by minimizing overall delay
• Plans at a detailed trajectory level for aircraft movement (gate, ramp, taxiways, and runways)
• Uses a fast algorithm suited to real-time operations
• Accounts for departures and arrivals
• Connects the airport tower, en route facility, and the airlines
• Adaptable to other airports with different configurations
SARDA Concept

Tower

FAA/Airport

• Runway sequence & time

Ramp

Aircraft

Gate push-back Management

• Reduce taxi delay
• Reduce fuel consumption and emissions/noise
• Increase predictability

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SARDA Scheduler Methodology

Tower (FAA)
- Runway Time Predictor
- Runway Scheduler
- Spot Time Calculator

Ramp (Airlines)
- Ramp Management System
- Push-back Time Predictor
- Push-back Time Calculator

Data Exchange
- Push-back times (scheduled/ready/actual)
- Airline constraints (e.g., priority)
- Target spot times

Handles uncertainties by frequent updates and freezing sequence for spot release and takeoffs/crossings

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Recent Results
SARDA HITL Simulation

- Two major simulations for DFW (2010, 2012)
- DFW experienced controllers
- Data collected on performance and controllers workload
Taxiing Delay for Departures
(Actual taxi time – Unimpeded Taxi Time)

- Observed reduction in taxiing delay statistically significant
- Reduction in mean as well as variance
- Reduction in variability and increase in predictability
SARDA resulted in statistically significant reduction in overall delay (p \sim 0.02)
Overall system delay reduced by an average of 1 minute per aircraft
Departure Taxi Fuel Consumption

- Observed reduction in fuel consumption: 23% average reduction in medium traffic and 33% average reduction in heavy
- SARDA reduces variability in fuel consumption
SARDA for CLT Ramp Operations
Ramp Sector Controller Workstation (Illustration Purpose Only)

SDSS Map

Electronic Flight Strips (EFS)

Gate Manager

(Touch screen)
US Airways-NASA Collaboration

• Goal - To develop and test a prototype DST for US Airways CLT ramp controllers for efficiency enhancement

• HITL simulations in three phases:
  – Phase 1: Building/testing core functions
  – Phase 2: Benchmark test
  – Phase 3: Follow-on tests

• Target dates:
  – Oct 2013 Completion of first HITL simulation
  – Aug 2014 Completion of benchmark test
  – Oct 2014 Completion of system integration at US Airways ramp tower
  – Sept 2015 Completion of field tests
Collaboration with DLR and NLR
NASA-DLR Collaboration

• NASA’s expertise
  – Surface decision support tool (e.g., SARDA)
  – Fast-time simulation and human-in-the-loop simulation capabilities
  – Flight deck based research on taxi conformance and trajectory-based surface operations

• DLR’s expertise
  – Research prototype of taxi management (e.g., Taxi Routing of Aircraft: Creation and Controlling (TRACC))
  – Arrival/departure management tools (AMAN/DMAN) and coordination

• Collaboration tasks
  – Compare surface management concepts between DLR and NASA
  – Develop a common integrated surface concept of operations
  – Evaluate DLR and NASA surface tools/algorithms in the other’s environment:
    • DLR models a US airport for testing TRACC
    • NASA models a German airport for testing NASA surface algorithm

- Ground Controller Advisories by SARDA (Dallas/Ft. Worth Airport)
- TRACC (Hamburg): a taxi route of a departure aircraft shown with speed advisories
NASA-NLR Collaboration

- **Goal:** Integrate NLR’s taxiway movement conflict detection technology with SARDA for a selected US Airport and conduct a HITL at NASA’s FFC.
- **NASA technology** – SARDA and high-fidelity HITL simulation
- **NLR technology** – Virtual Block Control (VBC) and Separation Bubbles (SBT)
- **Collaboration tasks**
  - Model a US Airport in NLR’s simulation environment and implement VBC in low visibility condition
  - Integrate NLR’s SBT in NASA’s Surface Management System (SMS)
  - Conduct HITL simulations at FFC and shadow mode tests
Questions?