

NAS Agent Behavior

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Fundamental Research on ATM at MIT

- **NAS Economics**
 - **ATM charges:**
R. Barocio-Cots (research paper, 6/99):
Impact on airlines and GA of ATM user charges based on distance and weight.
 - **Congestion pricing at airports:**
M. Jansson (SM, 5/98): Application of queueing theory to airport peak pricing.
 - **Baseline cost of delays:**
R. Barocio-Cots (research paper, 1/99): Cost to airlines and to their passengers.

Fundamental Research: NAS Agent Behavior

- Observations and modeling of taxi-out operations:
K. Andersson (SM, 6/99): Analysis of taxi-out operations at a hub airport.
B. Delcaire (SM, 6/98): Analysis of taxi-out operations at BOS.
+ I. Anagnostakis, H. Idris, W. Hall, N. Pujet (Ph.D. students): Numerous additional observations.
- Airline bank preservation:
P. Carlson (SM, 5/97): Scheduling inbound banks under reduced airport capacity conditions.
W. Hall (Ph.D., 6/99): Value of ATM-derived information
- Impact of regional jets at major airports:
J. Zickus (term project, 5/98): Three case studies

Fundamental Research: Metrics and Models

- Metrics:
A. Barnett and A. Wang: Safety metrics
A. Odoni and R. Barocio-Cots: Traffic efficiency metrics
- Queueing models:
M. Escobar (PhD, 9/98): Multi-Server queueing systems for en route sectors
- Models and simulations:
W. McDermott and M. Escobar (software project, 9/98): Enhancements to AND model

Taxi-out and departure ops: Objectives

- **Identify:**
 - **Where flow constraints occur under different conditions**
 - **Reasons that cause constraints to occur**
 - **Possible control points**
 - **Possible strategies that affect flow constraints**
- **Obtain insights into behavior of “agents”**
- **Conceptualize potential decision support tools**

Taxi-out and departure operations

- **Extensive BOS data analysis, 1996-98 (PRAS, ASQP, ETMS, station reports of two major airlines --25000 flights, hourly weather data)**
- **Numerous visits to BOS tower and TRACON, discussions with controllers (5 students)**
- **Different type of airport next**
- **Combines data analysis and methodology (stochastic processes, optimiz'n, queuing)**
- **Primary sponsor: NASA Departure Planner project; AOC synergies**

Queuing model for en route sectors

- M. Escobar (PhD, 9/98)
- Proposed use of dynamic queuing model to estimate workload, probability of saturation, waiting times at busy en route sectors
- $M(t) / Ek(t) / n / n+q$ model
- Developed efficient heuristics for solving
- Partially validated with data from Indianapolis sector (with LMI)
- Model already incorporated in LMINET and in AND

Approximate Network Delays (AND) model

- AND (Malone and Odoni, 1995): queuing network model of propagation of delay through a national or regional airport system
- Analogous to NASPAC et al., but entirely analytical (stochastic and dynamic)
- Uses as its “engine” DELAYS, a model for computing delays at a single airport
- Propagates delay by using flight schedules (i.e., aircraft itineraries)
- Used to explore effect of local or system-wide changes in airport demand and/or capacity

Enhancements to AND

- M. Escobar and W. McDermott (1998)
- Portable, PC-based
- New GUI facilitates use
- “Matching” algorithm for developing aircraft itineraries
- Simplified modification of demand (flight schedule)
- Improved statistical reports

Observations re. fundamental research

- Component which is not “mission-oriented”
- Essential to educational and research objectives of COE
- Mixture of short- and long-term projects; synergies with other sponsors
- Student research, empirical and methodological work
- Valuable in better understanding NAS