

Air Traffic Planning in an Uncertain World

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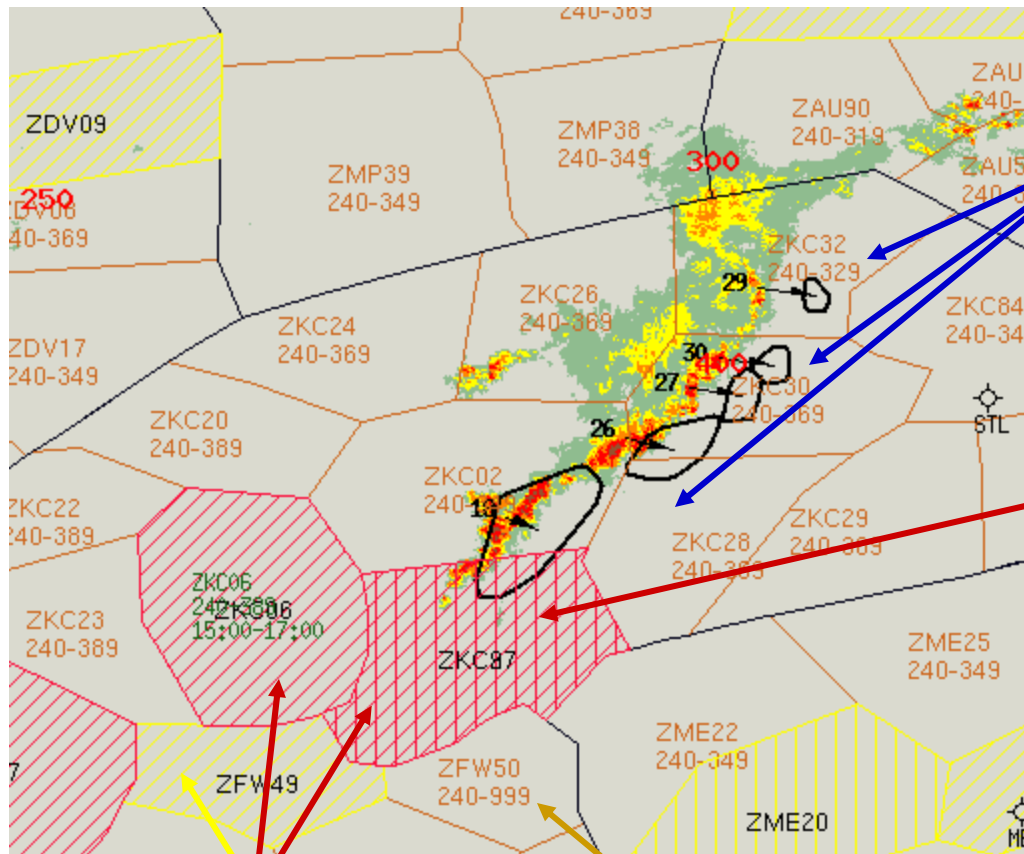
MITRE Sponsored Research



Problem

- **Air traffic planning decisions are based on imperfect predictions of traffic demand and capacity.**
 - This produces conservative decisions and unnecessary actions...
 - ...leading to excess delays and unused capacity.
- **By taking uncertainty explicitly into account, can we improve decision making?**

Background



Uncertain weather forecasts indicate future loss of airspace capacity...

Uncertain traffic forecasts determine airspace demand...

If demand exceeds capacity, delays will occur and safety may be compromised.

Given the uncertainty:
When should air traffic be restricted, and which flights should be affected?

Congestion Alerts

Air traffic control sector

Objective

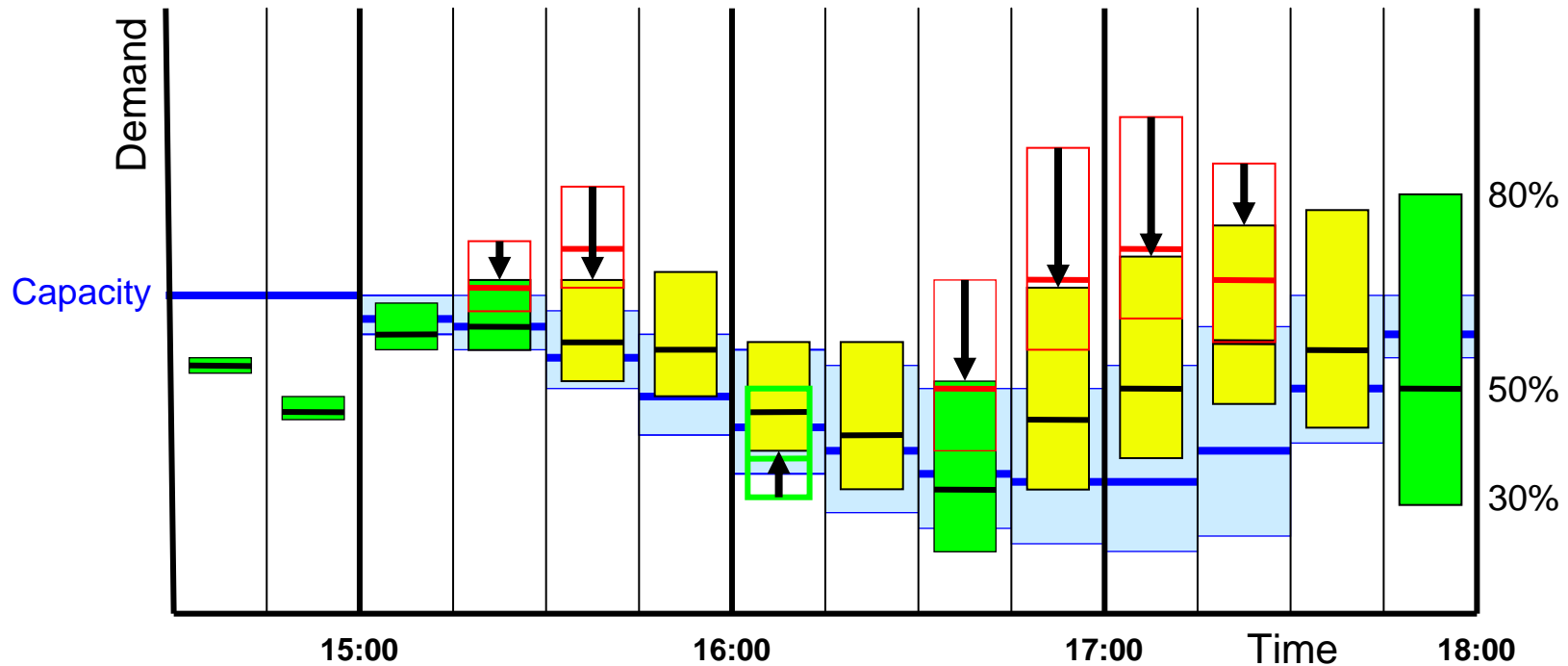
- **Develop practical computational approaches to automation-assisted traffic planning in the presence of uncertain demand and capacity**
 - **When to take corrective actions?**
 - **What actions to take?**

Activities

- **Define cost functions to mathematically reflect planning objectives**
- **Develop risk management algorithms that determine when to take corrective actions**
- **Derive problem resolution algorithms that choose corrective actions which minimize the chosen cost function**
- **Extend uncertainty modeling to predict airspace capacity in the presence of bad weather**

Highlight

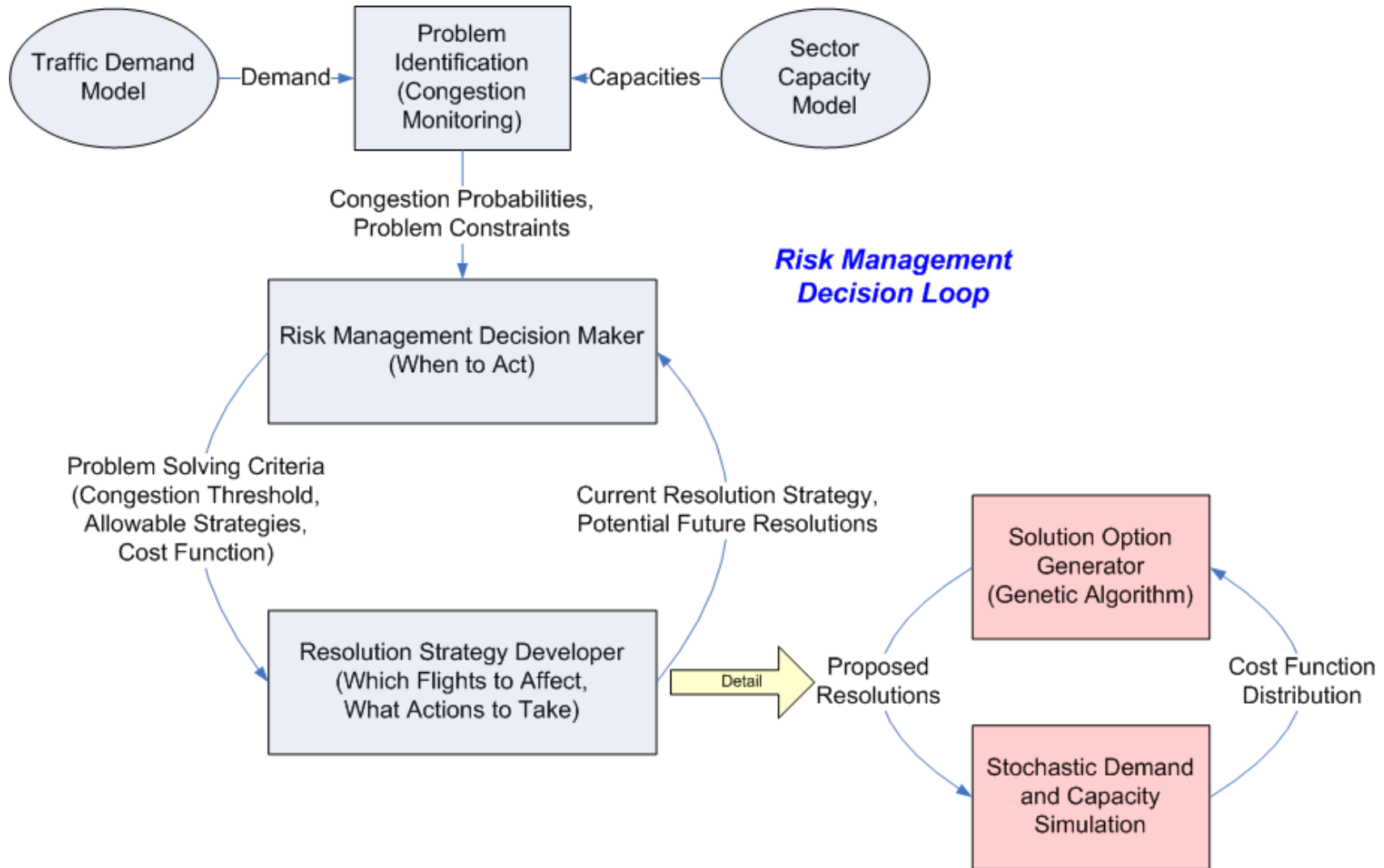
Managing Congestion to an Acceptable Level of Risk (Probability)



- Probability of congestion > 75%
- Probability of congestion > 50%
- Probability of congestion < 50%

Which flights to move?
Reroute? Delay? 4-D Constraint?
How to distribute impact?

Highlight



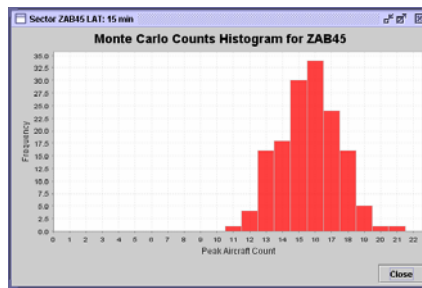
Impacts

- **Establishes the technology foundation for the FAA and CAASD future vision of air traffic management**
 - Targeted, situation-specific congestion management = greater air traffic efficiency
- **Supports nearer-term decision support efforts for the FAA**
- **Provides new, general-purpose tools for traffic simulation and airspace analysis**

Future Plans

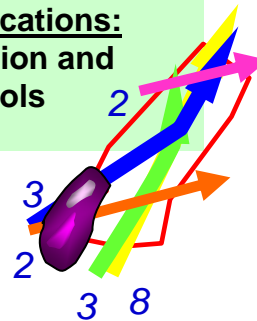
**Core Research:
Technologies for
Probabilistic Planning**

**Near-term Decision Support Applications:
Better Sector Capacity Prediction
Better Traffic Demand Visualization**



A screenshot of a software interface showing a table of traffic data. The table has columns for time intervals (1300, 1315, 1330, 1345, 1360, 1375, 1390, 1405, 1420, 1435) and rows for sectors (ZAB45 [15], ZAB45 [20], ZAB47 [10], ZAB49 [15], ZAB49 [15], ZAB49 [15], ZAB49 [15], ZAB47 [10], ZAB49 [15]). The cells contain numerical values, some highlighted in red or yellow.

**Near-term Analytical Applications:
Stochastic Traffic Simulation and
Airspace Analysis Tools**



**Future Vision:
A Decision Support
System for Probabilistic
Congestion Management**