Traffic Flow Management (TFM) in Fast-Time Simulation

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William J. Hughes Technical Center
Objective

“Identify the current and future state of Traffic Flow Management in Fast-Time Simulation”
Focus

• Survey existing models and methods for Traffic Flow Management (TFM)
• Identify future TFM concepts that might be considered for Fast-Time Simulation
• Assess whether existing models can be extended to address these concepts.
Topics

- Dynamic sectorization
- Multi-sector planner modeling.
- Introduction of an expanded TFM role (future concepts) such as the multi sector planner (how do we support this in modeling)
- Metrics (Limiting Factors) and alerting algorithms such as dynamic density or monitor alert (in the US) to support the traffic flow specialist
- Collaborative Decision Making (CDM) – are we interested in modeling the gaming/collaboration process?
- Cancellation and diversion of traffic – are these logic/decisions robustly represented in our current models?
Surveys

Aspects covered by current models:

<table>
<thead>
<tr>
<th>Ground Delay Program</th>
<th>CFMU contingency plan, preparation of exceptional events such as OG, transition phase, RVSM), pre-tactical ATFCM (ACC configuration assessment, optimization of regulation plan),</th>
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</thead>
<tbody>
<tr>
<td>Ground Stops</td>
<td>Assessment of ACC capacity</td>
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<td>ReRoutes</td>
<td>Calculate most effective way to increase ACC capacity in order to match a target average delay</td>
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<td>SWAP</td>
<td>ACC configuration optimization</td>
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<td>Coded Departure Routes</td>
<td>Complexity &amp; Capacity assessment</td>
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<td>Miles In Trail</td>
<td>Identification and selection of flows</td>
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<td>Slot allocation</td>
<td>Time based metering</td>
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<td>Departure planning information from CDM airport</td>
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<tr>
<td>Concept</td>
<td>Description</td>
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| Collaborative Decision Making (Identify Stakeholders) |  - Line of Flight  
  - Airline substitutions  
  - Flight cancellations  
  - Negotiation process between local TFM/Network Flow Manager/Planning Entity  
  - Models SWIM  
  - Models Air Traffic Controller behavior and exchange data with other ATM actors  
  - Manages movement of flight object to meet the needs of all of the ATM system stakeholders (e.g. AOC, FOC, Flight Deck, ATC, TM, etc).  
  - FOMS is described by the Target System Description and central to the support of advanced automation in the future ATM environment,  
  - Models TFM from ATCSCC, TMU, and AOC perspective. Three actors work collaboratively to resolve flow problems and capacities, models delegation of separation to the cockpit |
| Dynamic Sectorization                        |  - ACC configuration optimizer according to user constraints (max number of ATC WP during a time period, known configurations, user preferences for sector opening, min durations of configuration, etc.)  
  - Static reconfigurations, can choose different sector configurations during the simulation run.  
  - Supports the dynamic sectorization by allowing the dynamic construction of new sectorization from existing elementary building blocks |
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| Multi-Sector Planning | • MSP as defined by gate to gate project  
• MSP resolves conflicts ahead of time when the controller’s workload is expected to be high. |
| Flight Cancellations  | • Pseudo TFM simulation  
• AOC negotiates with TFM to swap slots or cancel flights |
| Flight Diversion      | • Applies any rerouting/FL capping, advancing, ground holding, etc., but during the strategic/pre-tactical ATFCM phases, i.e. not in real time.  
• Used to avoid SUA or bad weather zones |
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| Alerting Algorithms             | • Sector Loading for Monitor Alert  
| (i.e. Dynamic Density, Monitor Alert) | • Tactical load monitor                                                        |
| Traffic Metering                | • Traffic management and synchronization. Consists in spacing (MIT, min. in trail, and in merging flows). |
| Airspace Closure                | • Airspace Flow Programs  
|                                 | • Implied in a avoid airspace/beacon  
|                                 | • Mitigate strategically, pre-tactically and tactically the traffic affected by an airspace closure (e.g. radar outage, center closure) |
Surveys

Future Concepts for Fast-Time Modeling Consideration

• Dynamic Airspace
• 4D-management: Modeling airport and en-route operational/drifts in order to simulate satisfaction of TTO/TTA.
• Operational model of the Network Operations Plan.
• 4D contract
• Coordinated actions of pilot, service providers, and airline dispatch centers in managing flow problems.
Surveys

Extended Fast-Time Simulation

Component based architectures