Collision Avoidance for Airport Traffic

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Supporting Programs

AvSAFE – Integrated Intelligent Flight Deck Project

Crew Vehicle Interfaces (CVI)

NGATS ATM - Airportal Project

Safe & Efficient Surface Operations (SESO)

Surface collision avoidance flight deck technologies (information integration and presentation) for current and future NAS operations

Aircraft-based airport traffic collision avoidance algorithms for current and future NAS operations
Runway Incursion Prevention System

**Detection**

**IV. Know when a mistake occurs**
(Immediately alert flight crew & ATC)

**Avoidance**

**I. Know where you are**
Own-ship position awareness
(GPS & airport database)

**II. Know where others are**
Traffic position awareness
(ADS-B or TIS-B data link)

**III. Know where to go**
Route awareness
(Taxi route from ATC)

National Aeronautics and Space Administration*
Incursion Detection Methods

Aircraft-based algorithms:

- **Runway Safety Monitor (RSM)** - NASA in-house (Lockheed Martin)
  - Generic approach, not scenario dependent
  - Warning alerts generated

- **PathProx™** – Era Corporation (formerly Rannoch Corp.)
  - Developed under NASA Cooperative Research Agreement and SBIR
  - Handles 40+ specific incursion scenarios
  - Warning and cautionary alerts generated

- Conflict resolution advisories not provided

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Runway Incursion Alert on Approach
Recent Publications

Runway Incursion Prevention for General Aviation Operations


Runway Incursion Prevention for General Aviation Operations Simulation Study (RIPS-GA)

Objectives:
• For general aviation operations, evaluate incursion detection algorithm performance, surface awareness and alerting display concepts, pilot performance during runway incursion event

Method:
• Testing conducted in two phases
  – Rare Event Testing
  – Usability Study
• 16 general aviation pilots
# RIPS-GA Display Configurations

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (B)</td>
<td><img src="image1.png" alt="Baseline Display" /></td>
</tr>
<tr>
<td>B + Baseline Surface Map with Ownship only</td>
<td><img src="image2.png" alt="Baseline Surface Map with Ownship" /></td>
</tr>
<tr>
<td>B + Baseline Surface Map with Ownship and Traffic</td>
<td><img src="image3.png" alt="Baseline Surface Map with Ownship and Traffic" /></td>
</tr>
<tr>
<td>B + Audible Alerts</td>
<td><img src="image4.png" alt="Audible Alerts" /></td>
</tr>
<tr>
<td>B + Baseline Surface Map with Ownship and Audible Alerts</td>
<td><img src="image5.png" alt="Baseline Surface Map with Ownship and Audible Alerts" /></td>
</tr>
<tr>
<td><strong>“Warning, traffic departing 7”</strong></td>
<td><img src="image6.png" alt="Warning, traffic departing 7" /></td>
</tr>
<tr>
<td><strong>“Warning, traffic 16R”</strong></td>
<td><img src="image7.png" alt="Warning, traffic 16R" /></td>
</tr>
<tr>
<td>B + Baseline Surface Map with Ownship, Traffic, and Alerts</td>
<td><img src="image8.png" alt="Baseline Surface Map with Ownship, Traffic, and Alerts" /></td>
</tr>
<tr>
<td>B + Perspective Surface Map and Alerts</td>
<td><img src="image9.png" alt="Perspective Surface Map and Alerts" /></td>
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</tbody>
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*National Aeronautics and Space Administration*  
*Collision Avoidance for Airport Traffic*
RIPS-GA Results Summary

• Severe risk of collision occurred despite presentation of traffic on surface map (1 pilot, rare event study)

• Traffic presentation marginally beneficial unless alerting provided

• Alerts provided sufficient time to avoid potential conflict
  – On approach: Caution 35 seconds (5800’) from traffic
    Warnings 25 seconds (4100’) from traffic

• Alerting provides greater safety margins on departure
  – Aborted sooner, 2 to 6 seconds

• Audible alert minimum required, alert with map and traffic optimal

Pilots prefer:
  - Earlier alerting on approach with caution and warning alerts
  - Simple, quick alerting for departure and taxi
  - Descriptive alert with location and maneuver guidance
Current & Future Research Objectives

Continue and expand research in aircraft-based conflict detection and resolution (CD & R) concepts to ensure safe terminal area operations for current and future NAS operations

- Surface collision avoidance flight deck technologies (IIFD)
  - Crew/vehicle interface concepts
  - NGATS operations requirements
  - Mixed fleet equipage and operations
  - ATC interactions
  - Complementary airborne and ground conflict detection and alerting

- Aircraft-based airport traffic collision avoidance algorithms (Airportal)
  - Runway, taxi, and low altitude detection and alerting
  - Conflict resolution advisory feasibility
Taxi Conflict Detection
Supporting Activities

• NRA – Ohio University
  – Co-funded by IIFD & Airportal
  – Objectives:
    • Identify and characterize hazards
    • Characterize potential sensors
    • Develop models to use to evaluate various external hazard monitors
  – Focus on sensors for automatic detection of objects on or near runway during approach under adverse weather conditions

• RTCA SC-186 WG-1 participation
  – Develop an application description for initial flight deck-based traffic indications and alerting to an actual or potential high speed conflict on or near the airport surface that uses traffic surveillance information (for example, ADS-B)
FY08 CAAT Test Plans

• Usability study to obtain feedback on CAAT algorithms and alerting displays
  – Part of CVI piloted simulation study to evaluate critical safety issues associated with emerging NextGen concepts

• CAAT piloted simulation to evaluate conflict detection and alerting algorithms and pilot interface
  – Funded by Airportal Project
  – CVI research objectives included