ARL-Developed Routing Services in Support to the Tactical Airspace Integration System

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Outline

• Atmospheric Impacts Routing (AIR) Application Overview
• 3D Weather Impacts
• AIR Details
  • Current Status
  • Visualization
• Tactical Airspace Integration System (TAIS) – ARL Collaboration
• Summary
Atmospheric Impacts Routing (AIR)

Research Objectives:

- Improve survivability and movement efficiency of air and ground platforms and systems.
  - Develop routing technologies which allow avoidance of adverse weather and other obstacles during mission execution.
  - Develop technologies which facilitate decision-making for air and ground platform/system movements.

Warfighter Value/Impacts:

- Optimized air and ground movement.
- Decreased friendly force losses and increased mission success rates.
- More efficient use of platforms, weapon systems, and personnel.

Ongoing Coordinated Development:

- Tactical Airspace Integration System (TAIS, PEO Aviation) web services integration (AIR delivered Dec 2011).
- Coalition Attack Guidance Experiment II (CAGEII).
• AIR can utilize 3D weather impacts as input.

• My Weather Impacts Decision Aid (MyWIDA) Gen II will be a set of web services that a user can invoke (independent of the reference GUI, seen here) to determine 3D impacts on systems (ground or air).

• Resultant impact volume can be ingested and processed by AIR.

• Or, user can furnish the weather (or other) impacts independent of MyWIDA.
3D Weather Impacts (2 of 2)
• **AIR** calculates an optimized air (or ground) system route based on atmospheric impacts and obstacles along the path. *Path optimization employs A* search algorithm.*

• Both the **AIR Web Service** and **AIR View Standalone Application**:
  • Are written in Java (platform independent).
  • Ingest 3D “impact” grid(s) (e.g., weather impacts from MyWIDA).
  • Allow 3D volumes to be avoided.
    • E.g., areas of known threat; conflicting friendly activity; or other potential obstacles which may be represented as 3D volumes.
  • Generate output in industry standard Google Earth/Maps Keyhole Markup Language (KML).
• **AIR Web Service** (and reference client) prototype developed and successfully test-deployed on web service application server (Glassfish).

• **AIR View standalone (w/GUI):**
  - Output:
    - 2D plot (Java 2D graphics) including move time (hrs) and distance (km).
    - Google Earth KML output of optimized path.
    - Google Earth “fly-thru tour” along optimized path.
  - Can run from a CD.
AIR – Current Capabilities (service and standalone):

- **User inputs:**
  - Desired path (two or more waypoints).
  - Platform speed (m/s) for each segment.
  - Choice of “least risk” or “higher risk” routes for user decision-making.
  - Boundaries – vertical or 3D volumes (e.g., restricted airspace and “no-fly” zones).

- **Output:**
  - Google Earth/Maps KML AIR-generated *optimized path* (example in later slides).

- **Prototype Demonstration:**
  - Calculates approximately 1000 potential paths/routes per second in 3D space.
  - Successfully tested with 50 levels of 50x50 grids.
  - Successfully tested on multiple platforms (Windows, Linux).
AIR Visualization

AIR-generated 4D flight paths as “playback files” (Google Earth KML output format)

2 levels of “impacts” shown as additional layers.

Mission Start

Longer, Lower Risk Path

Mission End

Shorter, Higher Risk Path

Note: Constant height/2D only shown for visual clarity.
**TAIS Mission:** Provide automated Airspace Command and Control and enroute Air Traffic Services to users.

When Current Ops domains and Airtracks are displayed, operational impacts of weather on the airspace become readily apparent.
TAIS, 3D Weather Impacts, and AIR

RETURN: Google KML Route

RETURN: 4D Weather Impacts Grid

RETURN: 4D Weather Impacts Grid

Request Asset(s)

Request Route

Waypoints Route Choice Conflict Volumes

4D Weather Impacts Grid

Aircraft-Specific Weather Impacts Threshold Rules

4D Weather Forecast Grid

MyWIDA

TAIS
An optimized routing solution for air and ground movements can *increase mission success* rates and *decrease friendly force losses*.

- **Atmospheric Impacts Routing (AIR)** application and web service generate optimized paths through 3D grids of impacts/obstacles/adverse conditions.
- AIR output is in industry standard Google Earth/Maps KML.
- AIR development in progress to support *web service-based developments* within the Army (TAIS) and Air Force (AFWA).
- Recent *(Dec 2011)* delivery of AIR to supplement TAIS web services is in direct support to *Army airspace management*. 
Backups
AIR Inputs/Outputs

AIR View - Atmospheric Impacts Routing

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AIR PLOT - Locations for 45 Points
Box Dimensions (rows x cols x N): 15x15x5
Distance: 15.03 15.03, Time: 15.03 15.03

Layers
- Primary Database
- Borders and Labels
- Places
- Photos
- Roads
- 3D Buildings
- Ocean
- Street View
- Weather
- Gallery
- Global Awareness
- More
- Terrain

Imagery Data: June 8, 2012

Google

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