



National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Aerospace

Method and System for Air Traffic Rerouting for Air-space Constraint Resolution

National Airspace System (NAS) Constraint Evaluation and
Notification Tool (NASCENT)

NASA Ames Research Center's National Airspace System (NAS) Constraint Evaluation and Notification Tool (NASCENT) is a dynamic, ground-based, airspace constraint avoidance system that automatically analyzes routes of flying or predeparture aircraft, in or near constrained regions (due to weather, Special Use Airspace (SUA), etc.) It continuously analyzes time and fuel efficient reroutes around current and predicted constraints for thousands of flights in real-time. NASCENT provides an evaluation of operationally viable and historically implemented routes that save more than a user-specified number of minutes of wind-corrected flying time savings, for all the 20 Air Route Traffic Control Centers (ARTCCs or Centers) in the NAS, simultaneously. The system includes a flexible and intuitive graphical user interface that allows users to visualize, evaluate, modify (rubber-banding functionality), if necessary, and implement proposed reroutes (under current operational procedures).

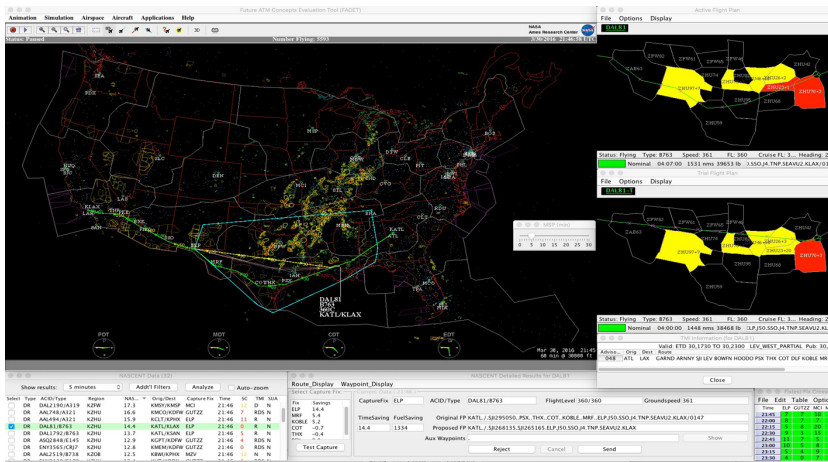
BENEFITS

- Simultaneously available in all 20 Centers
- Provides fuel savings and reduced delays
- Operationally viable and historically used route proposals
- Environmental emissions reduction
- Real-time handling of congestion, SUAs, TFRs, TMLs
- For airborne and pre-departure flights
- Air traffic data with one-minute updates
- Availability of Scheduled Times of Arrival at destination airport
- Agnostic of weather-model (FAA or Industry)
- NAS-wide simulation and analysis capability



THE TECHNOLOGY

National Airspace System (NAS) Constraint Evaluation and Notification Tool (NASCENT) employs a NAS-wide simulation and analysis infrastructure that implements airspace constraint avoidance algorithms for efficient routing. NASCENT uses NASA-developed aircraft performance tables for computing climb, cruise, and descent trajectories. Reference routes are created that save more than a user-specified number (e.g., five) minutes of flying-time savings. The return capture fix for the reference route is the last fix on the current flight plan within a limit region (derived using this patented technology). A Maneuver Start Point is selected to allow time for coordination of the reroute with the Federal Aviation Administration (FAA). These routes are checked against the weather polygons, FAA denoted Special Use Airspaces (e.g., Military Operations Areas) and Temporary Flight Restrictions (TFRs); and additional waypoints are added to avoid these airspace constraints. The wind-corrected flying-time savings are reported for each flight. The polygons are first converted into convex hulls and inflated by a user-specified number of nautical miles (e.g., 20, for weather) to account for the FAA requirements. Lateral and/or vertical advisories are created using a binary tree search along the left-side and right-side, up to the return capture fix, to find a minimum-deviation delay solution. The NASCENT system provides notification for congested sectors along the current flight plan and the proposed avoidance route, along with flights impacted by FAA imposed required Traffic Management Initiatives (TMIs, reroutes, Ground Delay Programs, etc.). The reroutes can be implemented with no changes required to the current FAA operational infrastructure.



Operational user display of NASCENT: current flight plan (green), historical routes (pink), and NASCENT advisory (yellow) with potential savings of 14.4 min. Houston Center (ZHU) limit polygon (cyan) is used to determine how far downstream a flight can go. Also shown are (counterclockwise) flight list (bottom left), individual flight result details, downstream fix loading, TMI (Playbook reroute) details, trial and current flight plan sector congestion. Maneuver Start Point (MSP) selection slider is shown in the middle of the display.

APPLICATIONS

The technology has several potential applications:

- Aerospace industry
- Air Traffic Management
- Airline Dispatchers
- Airline Air Traffic Control Coordinators

PUBLICATIONS

Patent No: 9,558,670

Sheth, K., McNally, D., Somersall, P., Morando, A., Clymer, A., and Shih, F., "Assessment of a National Airspace System Airborne Rerouting Tool," 11th USA/Europe Air Traffic Management Research and Development Seminar, Lisbon, Portugal, June 2015.

Sheth, K., McNally, D., Morando, A., Clymer, A., Lock, J., Petersen, J., and Shih, F., "Benefit Analysis of Multi-Center Dynamic Weather Routes," 14th AIAA Aviation Technology Integration and Operations Conference, Atlanta, GA, June 2014.

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More Information

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