



NASA technology minimizes weather-related flight delays, reducing costs and environmental impacts

National Aeronautics and Space Administration, **Ames Research Center**

Scientists at the National Aeronautics and Space Administration (NASA) Ames Research Center have developed an improved aircraft routing technology that can reduce weather-related flight delays while maintaining travelers' safety and keeping air traffic controllers and airline dispatchers in the loop.

In order to gain predictability and maintain safety, the Federal Aviation Administration (FAA) traffic managers implement Playbook Routes, tailored route solutions that are pre-coordinated with flight operators. During severe weather events, these routes reduce the workload on decision-makers; however, maintaining separation from the weather adds considerable flight length and time. Often, when the weather has dissipated or moved away, controllers do not have the time to proactively revisit and reoptimize the weather-avoidance routes that were approved preflight.

The NAS (National Airspace System) Constraint Evaluation and Notification Tool (NASCENT) technology is the first solution to recognize that the primary technical challenge is not computing a more efficient route alternative as compared with the state of the art. The primary technical challenge is to present to air traffic controllers a more efficient route that they can trust, easily process and ultimately approve, even amid the stress and chaotic tempo of severe weather operations.

NASCENT successfully overcame the trajectory optimization problem and the human factors problem simultaneously. NASCENT continuously looks for opportunities and proposes safe and efficient advisories that can bring the flights back on nominal routes, saving



Above: NASCENT in operation during evaluation at American Airlines Integrated Operations Center (IOC) in Fort Worth, TX.

time and fuel. Before the NASCENT invention, aircraft would often continue to fly the longer routes, wasting millions of pounds of fuel and causing some passengers to miss their connections.

The air traffic managers and flight operators desire a continuous search engine that provides them with safe opportunities to save time and fuel. NASCENT's proposed advisory routes are free of conflicts with weather, help reduce overall sector congestion, and avoid any federally designated special use/activity areas—while also accounting for safety and historically used routes to facilitate controller approval.

After the system has created and validated a new route, the user—typically an air traffic controller or a dispatcher—has the option to accept the advisory or modify it. The route change is communicated to the aircraft pilot, who requests clearance from the air traffic controller handling that flight. The controller accepts or rejects the request. If accepted, the pilot can safely fly the newly advised route.

Simulation experiments conducted by NASA suggest that, for the 30 most weather-impacted days of one summer, NASCENT innovation would have found more efficient re-routes for about 15,000 flights, saving airlines more than 135,000 minutes of flying time and about 4.2 million pounds of fuel. Previous research suggests these savings would also reduce harmful emissions by approximately 8%. And a time savings of even five minutes can prevent significant delays and missed connections that can have impacts across the airspace system.

Right: NASCENT Graphical User Interface for Airline Use. Situational display of traffic and weather, congestion, available opportunities, and individual flight information, along with FAA Traffic Management Initiatives.

