NASA SBIR 2008 Phase I Solicitation

A3.02 NextGen Airportal

Lead Center: LaRC

Participating Center(s): AFRC, ARC, LaRC

The Airportal research of NASA's Airspace Systems (AS) Program focuses on key capabilities that will increase throughput of the Airportal environment and achieve the highest possible efficiencies in the use of Airportal resources such as terminal airspace, runways, taxiways, and gates. The primary capabilities addressed are: (1) Super-density operations, (2) Equivalent visual operations, (3) Aircraft trajectory-based operations, and (4) Improved understanding of wake vortices.

Super-density operations will include conflict detection and resolution for closely spaced approaches, reduced aircraft wake vortex separation standards, and less restrictive run-way/taxiway operations. Additional mechanisms to increase the feasible density of operations will also be considered.

Equivalent visual operations will provide aircraft with the critical information needed to maintain safe distances from other aircraft during non-visual conditions, including a capability to operate at "visual performance" levels on the airport surface during low-visibility conditions. Advances in equivalent visual operations for the Airportal air navigation service provider are also of interest.

Aircraft trajectory-based operations will utilize 4D trajectories (aircraft path from block-to-block, including path along the ground, and also including the time component) as the basis for planning and executing system operations.

Wake vortices are often the ultimate limitation for many advanced, high-efficiency operational concepts. Advances in sensors, simulations of wake vortices and sensors, weather modeling and measurements, and understanding of impacts to aircraft flight are all of interest.

NASA's AS Program has identified the following Next Generation Air Transportation System (Next Gen) Airportal research activities: optimization of surface aircraft traffic; dynamic airport configuration management (including the optimal balancing of Airportal resources for arrival, departure, and surface aircraft operations); predictive models to enable mitigation of wake vortex hazards; new procedures for performing safe, closely spaced, and converging approaches at closer distances than are currently allowed; modeling, simulation, and experimental validation research focused on single and multiple regional airports (metroplex); and other innovative opportunities for transformational improvements in Airportal/metroplex throughput. Inherent to the AS Program approach is the integration of airborne solutions within the overall surface management optimization scheme.

In order to meet these challenges, innovative and technically feasible approaches are sought to advance technologies in research areas relevant to NASA's Next Gen/Airportal effort. The general areas of interest are surface management optimization, converging and parallel runway operations, safety risk assessment methodologies, and wake vortex solutions inside Metroplex boundaries. Specific research topics for Next Gen/Airportal include:

- Airborne spacing algorithms and wake avoidance procedures for airports with closely spaced runways;
- Algorithms for determining wake vortex encounters from aircraft flight data recorders;
- Automated separation assurance and runway/taxiway incursion prevention algorithms ;
- Automatic taxi clearance and aircraft control technologies;
- Characterization of wake vortex and atmospheric hazards to flight in terms of aircraft and flight crew responses;
- Collaborative decision making between airlines and airport traffic control tower personnel for optimized surface operations, including push back scheduling and management of airport surface assets;
- Development of wake vortex hazard assessment algorithms;
- Dynamic airport configuration management;
- Fusion of data from weather sensors and models for input into weather prediction models;
- High resolution CFD and real-time modeling of wake vortex strength and location;
- Human/automation interaction and performance standards;
- Improved wake vortex circulation estimates derived from Pulsed Lidar;
- Innovations in wake vortex sensors;
- Integration of decision-support tools across different airspace domains;
- Lidar Simulation tools for wake vortices;
- Measurements of wind, temperature, and turbulence from departing and arriving aircraft;
- Methodologies and/or algorithms to estimate environmental impacts of increased traffic on the surface and in the terminal airspace, and to reduce the environmental impacts under increased levels of traffic;
- Methodologies to estimate and assess the risk of transformational airspace operations for which little historical risk data may exist and for which operations may be constrained by the potential for extremely rare events;
- Modeling and simulation of airport operations for validating aircraft taxi planning concepts;
- Optimized 4D aircraft trajectory generation and conformance monitoring for surface and terminal airspace operations, including departure and arrival planning for individual flights;
- Radar simulation tools for wake vortices;
- Radically innovative approaches for detection of wake vortices;
- Scheduling algorithm for aircraft deicing and integration with a surface traffic decision-support tool;
- Surface and terminal airspace traffic modeling and simulation of multiple regional airports;
- Virtual airport traffic control towers;
- Weather sensors for supporting wake vortex predictions;
- Other technologies and approaches to achieving 2-3X improvement in the throughput of Airportal/metro-plexes.

Note: The development of technologies for the airborne detection of wake vortices is covered in Subtopic A1.04.