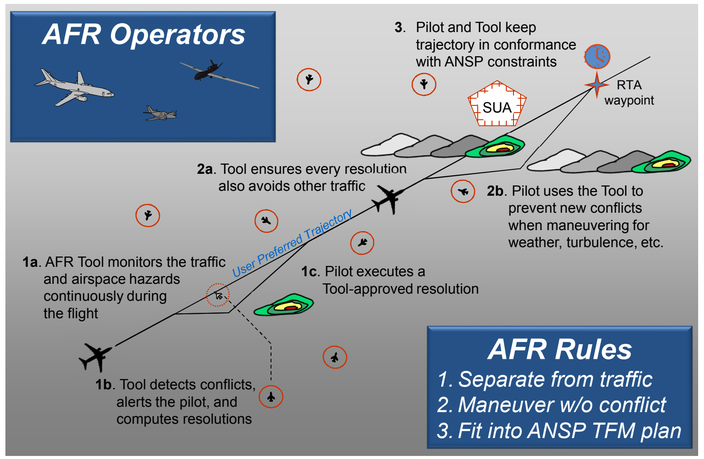
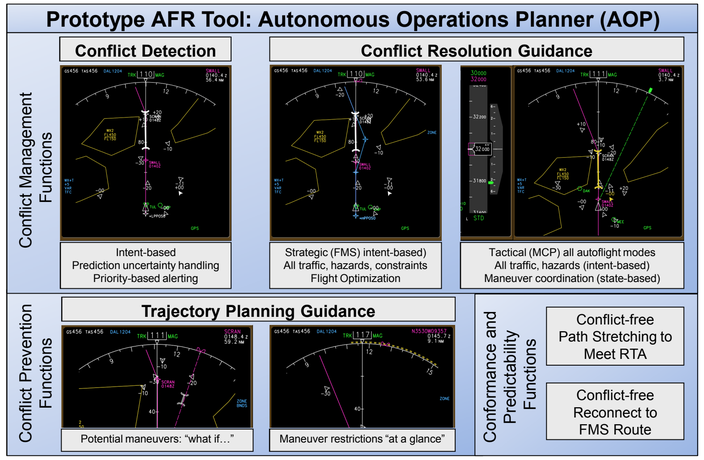
National Aeronautics and Space Administration

Autonomous Flight Rules (AFR): Research and Development of a Self-Separation Application of Airborne Surveillance in US Domestic Airspace





Expected Benefits

Safe
Redundancy from distribution of separation functions and responsibility enhances safety

Scalable
Minimizes workload bottlenecks and single-point failures; works with vastly increased traffic densities including swarms of UAS

Benefits airspace users
Greater flight efficiency and operational flexibility; fewer flight restrictions

Works in mixed environments
Facilitates transition; first aircraft receives benefits; ground-managed aircraft unaffected

Ground system savings
Primary infrastructure is airborne

R&D Accomplishments

Detailed concept defined and documented
Addresses mixed operations with IFR and VFR in shared airspace and perspectives of pilots, ANSP, and flight operations

Self-separation functions prototyped and integrated with modern avionics model
Supports pilot in strategic and tactical flight modes with conflict detection, resolution, and prevention; handles RTAs, SUAs, Wx hazards, fuel optimization

Algorithms stress-tested in random scenarios of very high density/complexity
Stressors also included pilot delays, wind errors, ADS-B range limits and interference, and dynamic weather hazards

Procedures and tools tested in dynamic human-in-the-loop simulations
Homogeneous and mixed operations, ~2x traffic density, metering w/ real-time rescheduling

Emerging Findings

Highly scalable with traffic demand
Sustainable far beyond current projections, even without complexity management initiatives

Compatible with highly-complex traffic environments
High traffic densities, unstructured flows, random conflict and traffic geometries, time constraints, airspace hazards

Tolerant of real-world, imperfect conditions
Human response variations, prediction uncertainties, surveillance system limitations

Integrates with current systems
Flight-deck systems, operations, procedures, mixed operations w/ ground-managed aircraft

Very satisfactory to pilots in simulations