

Project Summary/Abstract: Metrics for Operator Situation Awareness, Workload, and Performance in Automated Separation Assurance Systems

Under the Next Generation Airspace Transportation System (NGATS), airspace operators will assume new roles and responsibilities in reaction to several essential changes in air traffic management operations, and the introduction of new automation technologies to support these important developments. These extensive changes are being pursued to address the unprecedented growth in the demand for domestic and world air travel. The most critical of the impacted roles in NGATS will be that of pilot and air traffic controller. These new automation technologies such as Automated Separation Assurance Systems (ASAS) and Cockpit Displays of Traffic Information (CDTI), will significantly impact the workload and situation awareness (SA) of operators in future airspace systems. For these technological solutions to succeed, we must identify the information required of each new operator role, and measure the impact on operator situation awareness and workload. As existing measures of SA and workload inadequate, new measurement techniques must be developed that are reliable, valid, and sensitive to the changes in operator SA and workload caused by NGATS innovations.

We propose to develop methods for quantifying required and actual operator SA, workload, and performance in relation to operator (crew and controller) management of ASAS for safe operation under NGATS. These methods will target required and actual SA present under each operational concept, with particular emphasis on measuring individual and shared SA when ASAS schemes are being evaluated in dynamic airspace reconfiguration, and in super-density operations. To meet these objectives we have assembled a multidisciplinary team of universities and private industry with the technological capacity to conduct networked simulations to assess candidate SA, workload, and performance metrics for individual pilots and air traffic controllers, pilot-controller teams, and pilot-controller interactions with ASAS.

Our parallel-converging approach to the development and evaluation of SA, is characterized by systems analysis of NGATS concepts and identification of critical airspace scenarios, performed concurrently, with metric evaluations of existing and future measures of SA and workload. These parallel activities will drive the design of (scaled and full-scale) simulations to evaluate and validate candidate measures for their ability to reflect changes in operator SA, workload, and performance that might be induced by NGATS concepts. This analyze-simulate cycle will be repeated in each year of the proposed effort to determine individual and shared SA requirements, actual individual and shared SA, and workload in NGATS environments and with NGATS concepts identified by NASA as high-priority and critical.

The results of our research will give NGATS developers the tools and methods necessary for evaluating ATM schemes in terms of SA, workload, and the impact these constructs have on system safety and performance. Moreover, our consortium of academic and industrial organizations will further the development of needed skills and core competencies in aeronautics for future aerospace professionals.