Phase II Project Summary

Firm: Intelligent Automation, Inc
Contract Number: NNX10CA03C
Project Title: ACES-based Testbed and Bayesian Game-theoretic Framework for Dynamic Airspace Configuration

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)
The goal of Dynamic Airspace Configuration (DAC) concepts is to maximize airspace capacity to accommodate NetxGen traffic demand beyond what can be achieved by closely separated and spaced procedures based on advanced equipage and avionics. The goal of Trajectory based Strategic Global Traffic Flow management (GTFM) concepts to manage the traffic demand to meet the capacity such that it results in minimum flight delays or maximize throughput. There is an implicit dependency between the two concepts. A GTFM concept manages the demand by introducing airborne delays, which requires controllers to issue instructions and thus adds to the very controller workload that is balanced by a DAC concept. A DAC concept uses the very flight tracks that are altered by TFM delays, in partitioning airspace and distributing workload among sectors to create additional capacity.

However, existing GTFM and DAC models do not account for the implicit dependency and cannot be just used in the current state of definition to develop an integrated DAC-TFM concept. Furthermore, there is no simulation framework to study interaction between these two concepts. This project addresses this gap by developing new GTFM and DAC models and developing a Planning Cycle Framework in ACES for DAC-TFM interaction study.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)

Technical objectives consists of i) Developing a framework to study integrated DAC-TFM concept, ii) Developing DAC and TFM models for integrated DAC-TFM concept, and iii) Demonstrating how DAC-TFM solution converge using ACES simulation testbed

The technical work plan consists of following tasks: i) Implementing and integrating a Planning Cycle Framework (PCF) into ACES, ii) Developing a Global TFM model that uses DAC constrained airspace in delay assignment, iii) Developing a DAC model that uses ATC workload for meeting TFM restrictions in airspace partitioning, and iv) Evaluating and analyzing integrated DAC-TFM concept using PCF

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)
IAI developed a Planning Cycle Framework (PCF) to study integrated DAC-TFM Concept. The PCF is integrated with ACES and can be used to study how Global Traffic Flow Management (GTFM) concepts and Dynamic Airspace Configuration (DAC) concepts interact to determine maximum capacity airspace and assign flight specific ground and airborne delays to manage the traffic demand in meeting the capacity. In this effort, a flight specific sector-level ATC feasible and airline preferred TFM Delay Distribution Model (DDM) was developed for GTFM and Delay Management centric DAC model was developed to evaluate and enable convergence to a DAC-TFM solution during a planning cycle. The simulation results show that DDM distributes delays over large number of flights while keeping the average delays per flight same as the results without DDM. Furthermore, ATC feasible delays do not increase ATC workload and by distributing the delays over large number of sectors, the workload balance is maintained. DDM resulted delays can also be transformed into Time based Flow Management (TBFM) restrictions or tactical TFM restrictions. Finally, the inclusion of Delay Management centric workload or Simplified Dynamic Density (SDD) definition into incremental DAC model enables researchers to study the implicit interaction between DAC and TFM concepts.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)
The outcome of the project can be applied to following NASA applications i) The software provides a simulation capability to perform and study DAC and TFM planning concepts, ii) The Global TFM with DDM can be used with DAC concepts to generate ATC feasible delay maneuvers – an important contribution to NASA researchers, and iii) The principles of the incremental DAC model with Delay Management centric workload computation can be use to modify other DAC concepts/models

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)
The project has applications to FAA and JPDO research community in identifying requirements of NextGen concepts in increasing capacity to meet the future demand

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