Active Project (2016 - 2018)

An Optimality Metrics Reporting Toolkit for SMART NAS, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

This SBIR project aims to develop a software module for the SMART NAS Test Bed (or another similar simulation environment) that allows an apples-to-apples comparison of system performance across scenarios and a comparison to a 'best possible' case. The module, named TOMO (Toolkit for Optimality Metrics Overlay), is a metrics toolkit for comparing SMART NAS simulation runs to the optimal decisions that should be made/should have been made relative to a selected metric to help compare the performance of the scenario being simulated to a best possible outcome, either in shadow-mode or in post-operations mode. The output from TOMO is not only a normalized metric, but the 4-D trajectories of all aircraft in an optimally-performing system. A key component to the success of any simulation environment is the quality of the metrics that it is able to report back to a user to allow informed decision-making. TOMO addresses the need to develop metrics that are comparable across scenarios by computing a 'baseline' for each scenario that represents the best that the system could perform given the operating constraints, weather, and demand. By normalizing metrics relative to this baseline, it allows for more direct comparisons across scenarios along multiple dimensions both in shadow mode and playback scenarios. When used in shadow mode, TOMO will identify the actions that should be taken to optimize for a given objective. In addition to computing the metrics, TOMO's output includes descriptive information on how the trajectories in the scenario being simulated differ from those in the optimal solution, and provides insight into how system performance may be improved.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The core application of the work in this project will be to further NASA's goals to enable safe and efficient Trajectory-Based Operations, and to

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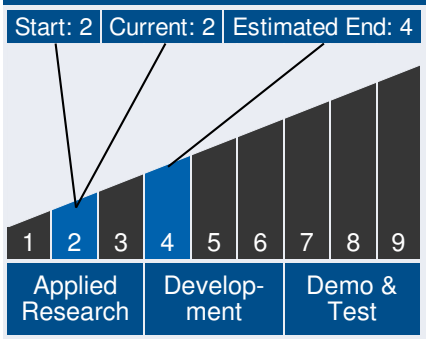
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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develop a decision-support capability to enable better decision making. SMART NAS will be the primary application of TOMO; we envision that TOMO can be plugged into SMART NAS as a module enabling metrics computation and comparison. TOMO will display its results on a convenient user interface, to allow SMART NAS users to readily make informed decisions. If successful, it is envisioned that TOMO will not only integrate with SMART NAS to enable scenario simulation and evaluation, but will also provide output on the optimal trajectories that will promote new learning and improved decisions. TOMO can also be used for post-operations evaluation of the existing system and be integrated with real-time data feeds such as SWIM to allow TOMO to be run in playback or shadow mode.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The FAA will have similar interest in TOMO as would NASA, by leveraging TOMO's powerful decision support capability. These simulation and experimental needs are shared by other non-NASA organizations, especially those who possess or are developing large-scale air transportation simulators. Those organizations include Embry Riddle Aeronautical University, MITRE-CAASD, and Volpe. Each of these organizations has a European counterpart with comparable roles and interests. Those organizations include EUROCONTROL, SESAR, and the Ecole Polytechnique. Furthermore, there are many foreign air navigation service providers (ANSP), who are the counterpart of the FAA, with burgeoning air traffic management systems that could benefit from decision support tools for better trajectory planning and understanding of the cost/benefit tradeoffs of flow management initiatives. In some respects, these are even more viable customers for our product than the FAA, because their air traffic management systems are less highly developed (in some cases, nascent) and, therefore, able to incorporate new subsystems. Countries with such ANSPs include South Africa, the Dominican Republic, Australia, and Colombia.

Management Team *(cont.)*

Principal Investigator:

- Bala Chandran

Technology Areas

Primary Technology Area:
Modeling, Simulation, Information Technology and Processing (TA 11)

- Simulation (TA 11.3)
  - Simulation-Based Systems Engineering (TA 11.3.3)

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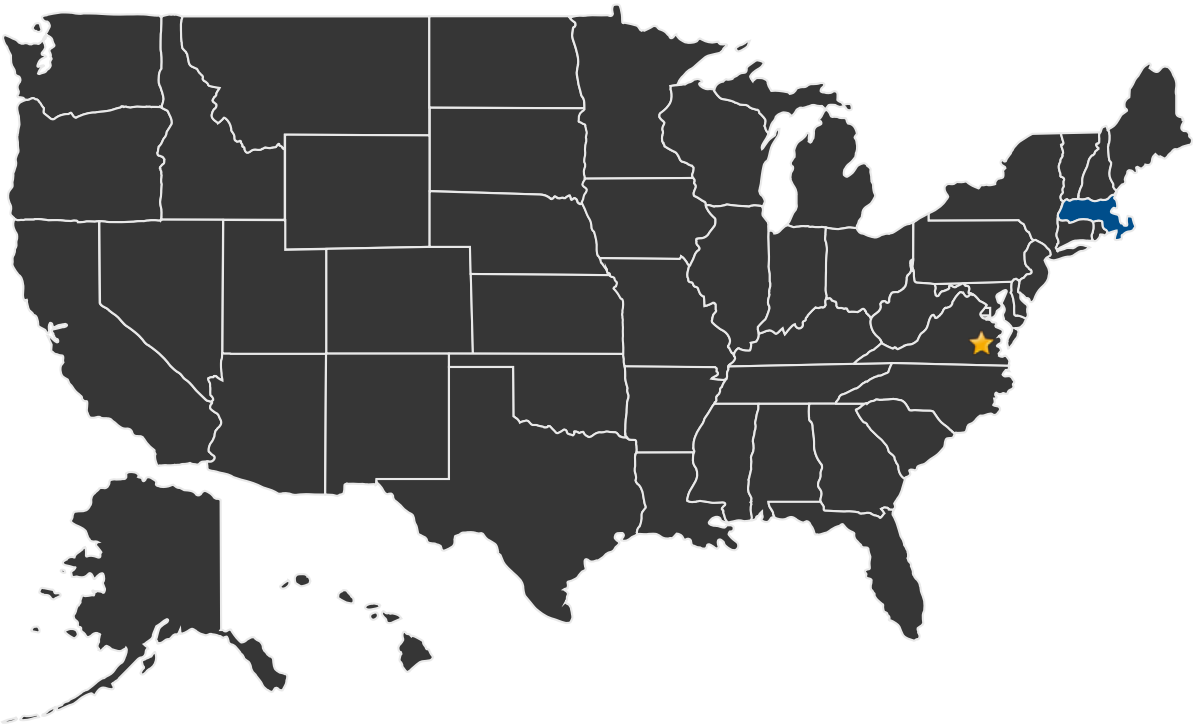
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

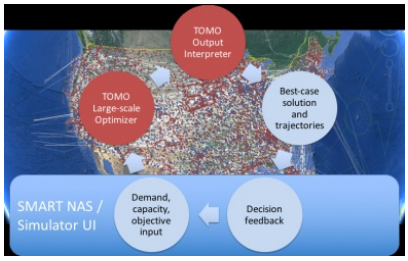
- Resilient Ops, Inc (Winchester, MA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23297)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

An Optimality Metrics Reporting Toolkit for SMART NAS, Phase II

Potential Applications

The core application of the work in this project will be to further NASA's goals to enable safe and efficient Trajectory-Based Operations, and to develop a decision-support capability to enable better decision making. SMART NAS will be the primary application of TOMO; we envision that TOMO can be plugged into SMART NAS as a module enabling metrics computation and comparison. TOMO will display its results on a convenient user interface, to allow SMART NAS users to readily make informed decisions. If successful, it is envisioned that TOMO will not only integrate with SMART NAS to enable scenario simulation and evaluation, but will also provide output on the optimal trajectories that will promote new learning and improved decisions. TOMO can also be used for post-operations evaluation of the existing system and be integrated with real-time data feeds such as SWIM to allow TOMO to be run in playback or shadow mode.