

An Intelligent Consumables Management System Development Framework based on Artificial Intelligence Techniques, Phase I Project

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



ABSTRACT

The proposed innovation, called the Management of consumables Adaptive Execution, SynchronizaTion, Replanning/rescheduling, Optimization system (MAESTRO), would leverage the investment of NASA from originally funding the development of the Aurora Intelligent Scheduling framework and also leverage the previous NASA-funded Intelliface, to interface Aurora to diagnosis systems and extend it both to include more Course of Action (COA) development/planning and adaptive execution (i.e., executing the scheduled activities/procedures after scheduling). MAESTRO would be an open standards architecture and framework for the development of intelligent consumables management systems for autonomous and/or astronaut management of consumables. Each task (an abstract token) in a MAESTRO/Aurora schedule would be a procedure of several steps or actions that must be executed, and incorporating the Adaptive Execution capability of Intelliface (based on Open Source SimBionic) would allow the plans and schedules generated by MAESTRO to be adaptively executed. The Intelliface link to diagnosis systems allows the entire loop to be closed so that an autonomous or human-interfaced system can transition seamlessly between diagnosis, replanning, rescheduling, adaptive execution, etc. The generality of the proposed MAESTRO system will be proven, in Phase I, by using it to develop three separate consumable management systems for three separate applications using the same code base. Consumables management will be possible with significantly less skill and experience, less manpower, and reduced turnaround time. The multiple applications also show that MAESTRO is a general, open architecture.

ANTICIPATED BENEFITS

To NASA funded missions:

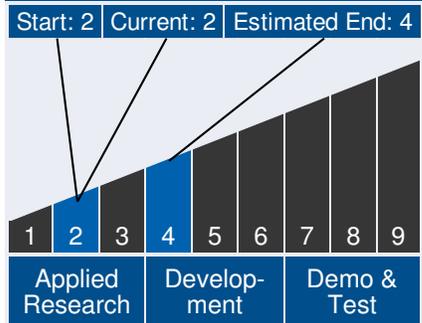
Potential NASA Commercial Applications: The most direct



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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targets for transition of this proposed effort are the large number of intelligent consumables management systems needed for the several systems onboard various future manned and unmanned spacecraft. By showing its ability to create high-quality responses to consumables events with greatly reduced manpower and expertise, MAESTRO will clearly illustrate its advantages over the status quo. Because it will be an open system that other developers could use to create intelligent consumables management, a large number of intelligent consumables applications can be quickly developed. Since MAESTRO is specifically designed to easily interface with Diagnosis, Adaptive Execution, and Planning engines, such developers will have their choice. And additional interfaces can be developed over time to increase the number of such options. There is a potential to automate the majority of consumables management decision-making at NASA, even for low earth orbit, with a corresponding savings in highly skilled manpower. Additional applications are various types of ground processing at KSC.

To the commercial space industry:

Potential Non-NASA Commercial Applications: On the commercial side, Stottler Henke already sells Aurora and associated customization services to private companies. Commercial product and service sales related to Aurora have already resulted in over \$8 million in revenue. MAESTRO improvements can be readily incorporated into Aurora and sold through existing sales channels. And beyond NASA there is a large number of real-time diagnosis, replanning/rescheduling, and execution problems that MAESTRO could be readily adapted to such as oil refineries, power plants, factories of all types, etc. And many of these potential MAESTRO users are already Aurora customers.

Management Team (cont.)

Program Manager:

- Carlos Torrez

Principal Investigator:

- Richard Stottler

Technology Areas

Primary Technology Area:

Robotics and Autonomous Systems (TA 4)

└ System-Level Autonomy (TA 4.5)

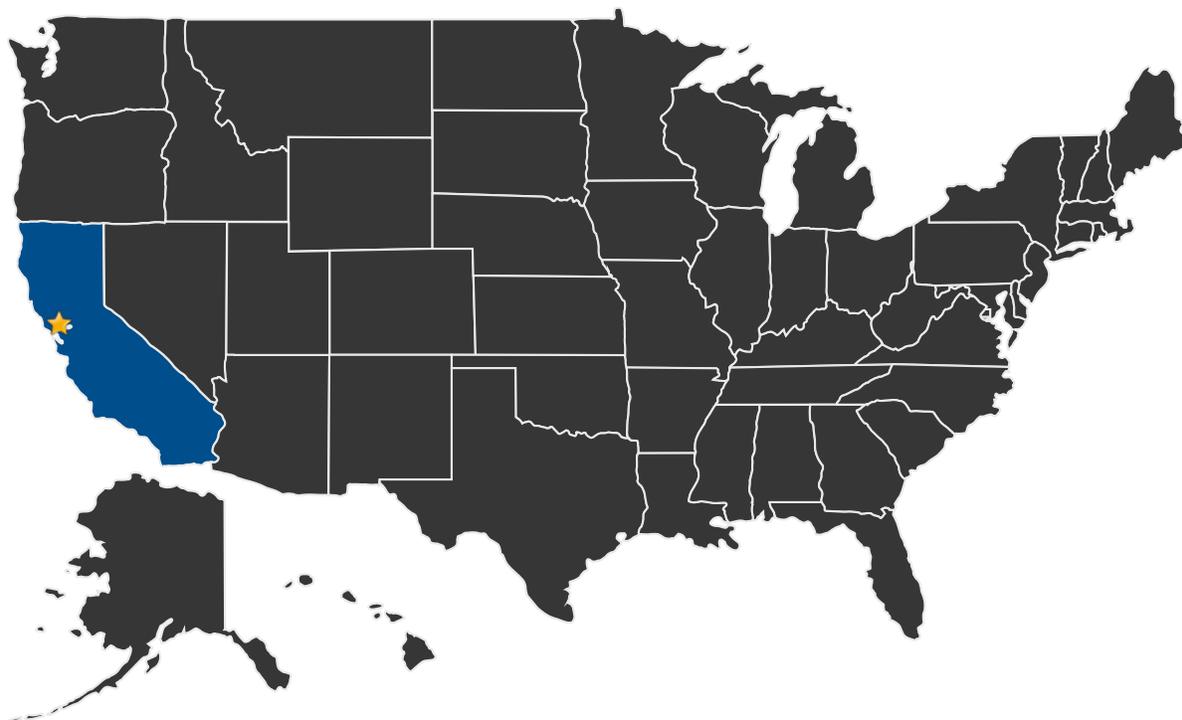
└ Multi-Agent Coordination (TA 4.5.4)

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U.S. WORK LOCATIONS AND KEY PARTNERS



- U.S. States With Work ★ **Lead Center:**
Ames Research Center

Other Organizations Performing Work:

- Stottler Henke Associates, Inc. (San Mateo, CA)

PROJECT LIBRARY

Presentations

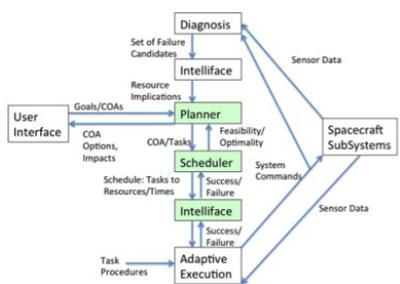
- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23271>)

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IMAGE GALLERY



An Intelligent Consumables Management System Development Framework based on Artificial Intelligence Techniques, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

The most direct targets for transition of this proposed effort are the large number of intelligent consumables management systems needed for the several systems onboard various future manned and unmanned spacecraft. By showing its ability to create high-quality responses to consumables events with greatly reduced manpower and expertise, MAESTRO will clearly illustrate its advantages over the status quo. Because it will be an open system that other developers could use to create intelligent consumables management, a large number of intelligent consumables applications can be quickly developed. Since MAESTRO is specifically designed to easily interface with Diagnosis, Adaptive Execution, and Planning engines, such developers will have their choice. And additional interfaces can be developed over time to increase the number of such options. There is a potential to automate the majority of consumables management decision-making at NASA, even for low earth orbit, with a corresponding savings in highly skilled manpower. Additional applications are various types of ground processing at KSC.