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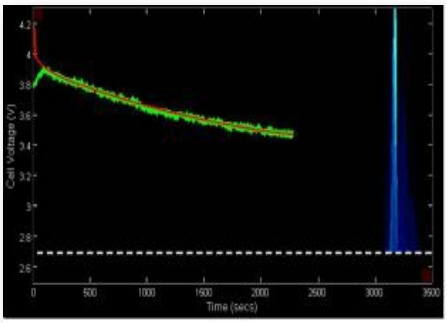
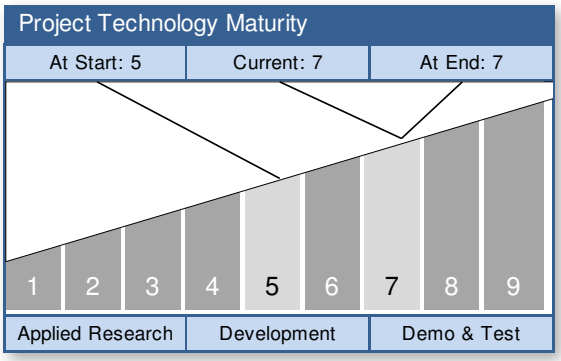
Advanced Ground Systems Maintenance Prognostics Project

Human Exploration And Operations Mission Directorate (HEOMD)

National Aeronautics and Space Administration



End of charge estimation (blue curve) for battery. Green curve shows estimated voltage during discharge.



ABSTRACT

The project implements prognostics capabilities to predict when a component, system or subsystem will no longer meet desired functional or performance criteria, called the "end of life." The capability also provides an assessment of the "remaining useful life" of a hardware component. The project enables the delivery of system health advisories to ground system operators.

Technology Area: Ground & Launch Systems Processing TA13 (Primary)
Robotics, Tele-Robotics & Autonomous Systems TA04 (Secondary)

ANTICIPATED BENEFITS

To NASA funded missions:

Prognostics provides information about the health status of components and predictions about their remaining useful life. The degree of wear or damage can be tracked and visualized to help support human-in-the-loop decision-making. Prognostics can also be used as part of decision-making

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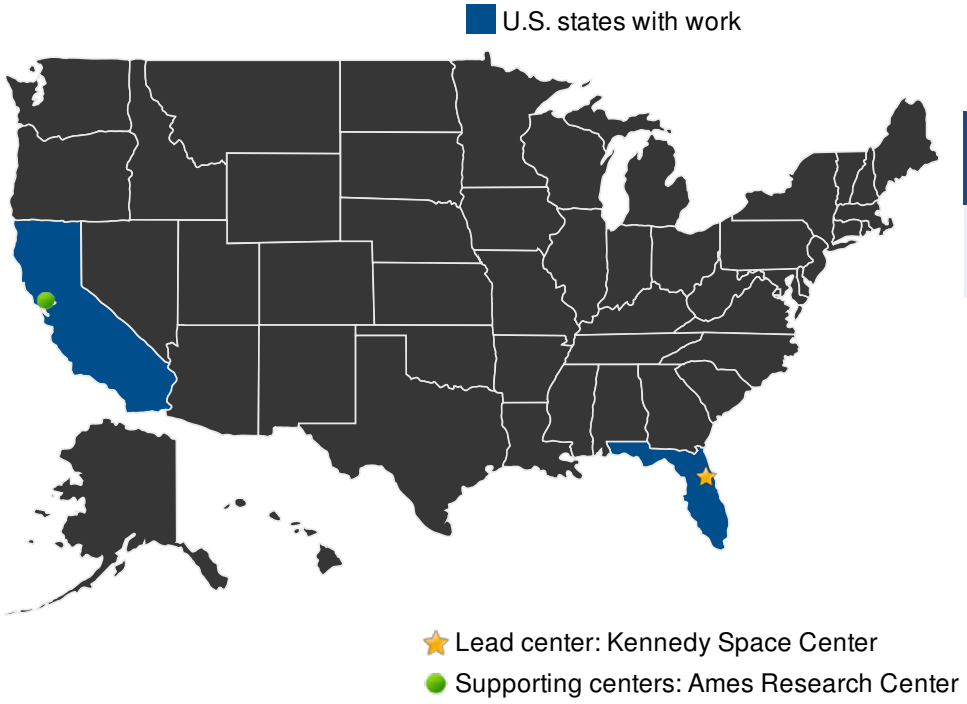
Read more on the last page.



Other Organizations Performing Work

Stinger Ghaffarian Technologies

DETAILED DESCRIPTION

This project will use modeling techniques and algorithms to assess components' health and predict remaining life for such components. The prognostics capability being developed will be used:

- during the design phase and during pre/post operations to conduct planning and analysis of system design, maintenance & logistics plans, and system/mission operations plans
- during real-time operations to monitor changes to components' health and assess their impact on operations.

This capability will be interfaced to Ground Operations' command and control system as a part of the AGSM project to help assure system availability and mission success. The initial modeling effort for this capability will be developed for Liquid Oxygen ground loading applications.

MANAGEMENT

Program Executive:
Michael Bolger

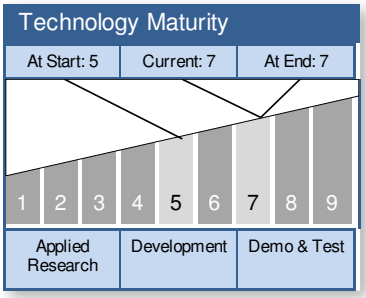
Program Manager:
Kirk Lougheed

Project Manager:
Barbara Brown

Principal Investigator:
Barbara Brown

TECHNOLOGY DETAILS

Advanced Ground Systems Maintenance Prognostics Project



TECHNOLOGY DESCRIPTION

Prognostics is performed through an analysis of available sensor data. Signs of aging, or damage, are correlated with mathematical models of how components wear and degrade over time in order to identify the damage progression model and the rate of wear or degradation. Identification of the rate of damage progression enables predictions to be made as to the remaining life and time at which aging or damage will cause the component or system to fail. The prognostics capability can be used during the design stage, to help define maintenance and logistics plans, to monitor real-time changes in component health, and to assess the impact on operations.

This technology is categorized as a software macro for engineering, design, modeling, or analysis

- Technology Area
  - TA13 Ground & Launch Systems Processing (Primary)
  - TA04 Robotics, Tele-Robotics & Autonomous Systems (Secondary)
  - TA06 Human Health, Life Support & Habitation Systems (Additional)

CAPABILITIES PROVIDED

Prognostics enables informed decisions to be made about whether, and how, to continue to operate a system given anticipated usage profiles. In addition, unscheduled maintenance can be avoided, predictable catastrophic events can be prevented, and component life can be extended. The prognostics capability can be used during the design stage, to help define maintenance and logistics plans, to monitor real-time changes in component health, and to assess the impact on operations. Operations personnel can use prognostics software to improve the safety of operations and to reduce life cycle cost of operations.

POTENTIAL APPLICATIONS

Prognostics capability enables condition-based maintenance of systems components instead of the traditional schedule-based maintenance approach presently used, leading to extended component lifetimes and reduced operation and maintenance costs. Prognostics capability produces

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Read more on the last page.

IMAGE GALLERY

Researcher Dr. José Celaya readying an aging experiment for electronics.

PROJECT LIBRARY

Images

- End of charge estimation (blue curve) for battery. Green curve shows estimated voltage during discharge.

  (https://techport.nasa.gov/fetchFile?objectId=1941)

- Researcher Dr. José Celaya readying an aging experiment for electronics.

  (https://techport.nasa.gov/fetchFile?objectId=1942)

ANTICIPATED BENEFITS

To NASA funded missions: (CONT'D)

processes in autonomous systems. Launch operations can be supported with prognostics-informed go/no-go decisions. Avoiding unscheduled maintenance and supporting condition-based maintenance will lead to reduced costs and risk.

TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

valuable information about components present and future health, allowing for systems operators to "act" instead of "react" to problems.

Prognostics capability benefits applications with multiple launch complex users/customers by minimizing operations and maintenance costs and increasing systems' availability.

This capability reduces schedule, costs, performance and availability risks while infusing new technology in the launch complex ground operations. Ultimately, this capability contributes to the migration from traditional systems and operations to autonomous systems and operations