



Aviation Safety Program

Integrated Vehicle Health Management Project

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National Aeronautics R&D Policy and JPDO NextGen R&D Plan

“Develop technologies to reduce accidents and incidents through enhanced vehicle design, structures, and subsystems.”

“Aircraft-level health-management systems, including sensors and analytical tools, will be developed that will identify problems before accidents occur. Research in health management requires not only monitoring and detecting, but also confident prognostics of latent potential failures before they occur ... with extensive verification and validation of automation systems.”

National Plan for Aeronautics Research and Development and Related Infrastructure

JPDO NextGen Research and Development Plan



Overview

Level 4 – Aircraft Level

Goal -- Validated multidisciplinary integrated vehicle health management tools and techniques to enable automated detection, diagnosis, prognosis and mitigation of adverse events during flight.

IVHM 4.1 Ground/ Flight Demo

IVHM 4.2 Systems Analysis

IVHM 4.3 Dashlink

IVHM 4.4 Research Test and Integration

Level 3 – Themes

IVHM 3.1 Detection

IVHM 3.2 Diagnosis

IVHM 3.3 Prognosis

IVHM 3.4 Mitigation

IVHM 3.5 Integrity Assurance

Level 2 – Subsystems

IVHM 2.1 Aircraft Systems HM

IVHM 2.2 Airframe HM

IVHM 2.3 Propulsion HM

IVHM 2.4 Software HM

Level 1 – Foundational

IVHM 1.1 Advanced Sensors and Materials

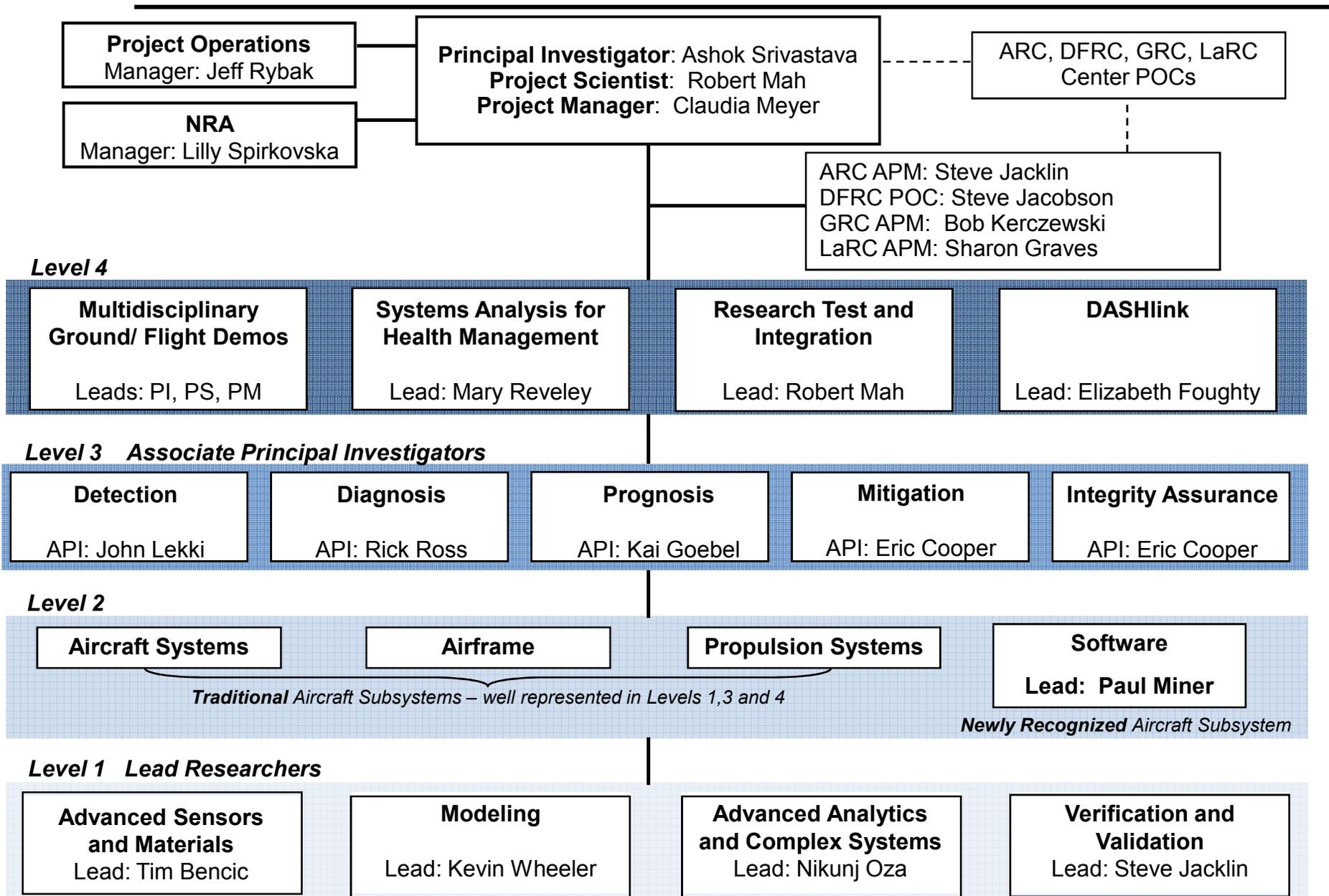
IVHM 1.2 Modeling

IVHM 1.3 Advanced Analytics and Complex Systems

IVHM 1.4 Verification and Validation



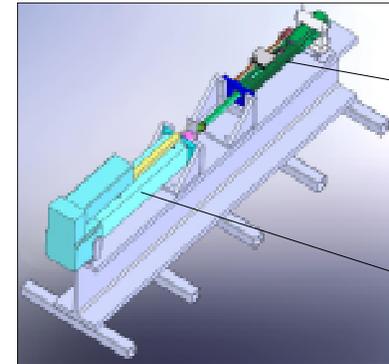
Organization





NRA University and Industry Partnerships - Prognosis

Round	Proposal Title	Institution	Supports IVHM 2.0 Milestones
1	Ultra Efficient Multiscale Prognostic and Diagnostics Tools for Airframe and Propulsion Structures	Collier Research Corp.	1.2.2.4, 1.2.2.5, 1.2.3.4
1	An Integrated Vehicle Health Management Approach to Heterogeneous Structural Systems	Arizona State University	1.2.2.2, 1.2.2.4, 1.2.2.5, 1.2.3.4
2	Development of Early-Indicators for Failure-Prognosis of Power Semiconductor Devices	Auburn University	1.2.3.2, 1.2.3.3
2	Diagnostics and Prognostics for Electro-Hydro-Mechanical Systems	Impact Technologies, LLC	1.2.3.1, 1.2.3.2
2	Reliable Diagnostics and Prognostics for Critical Avionics Systems	University of Maryland	1.2.3.2, 1.2.3.3



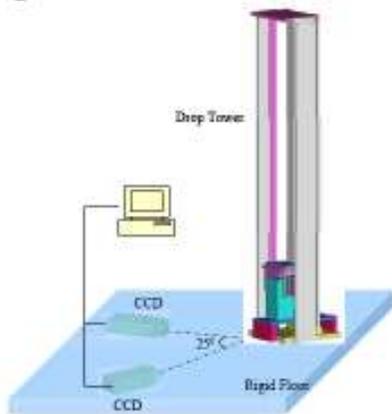
Test EMA: Moog 883
Stroke: 30.5 cm
Speed: 150 mm/sec



Load EMA: Moog 886
Force: 5 Metric Tons
Speed: 150 mm/sec



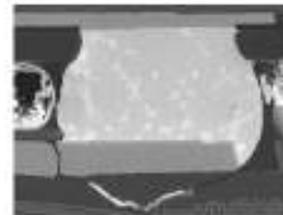
- Candidates for EMA Failure Mode Focus Established
- Dynamic model of 'Generalized' EMA created
 - will be used to represent physics of degradation



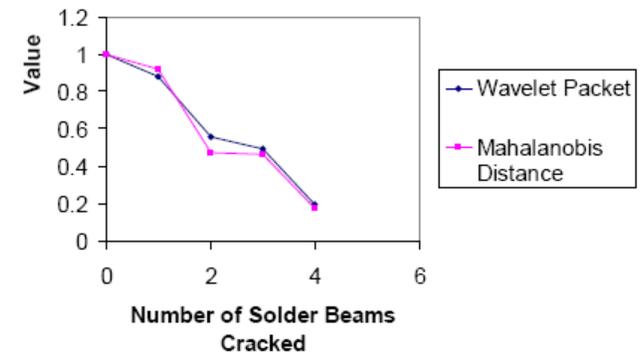
Vertical (0-Degree) Drop



Pad I/O PCB side Resin Crack



Cracking of Copper and Laminate

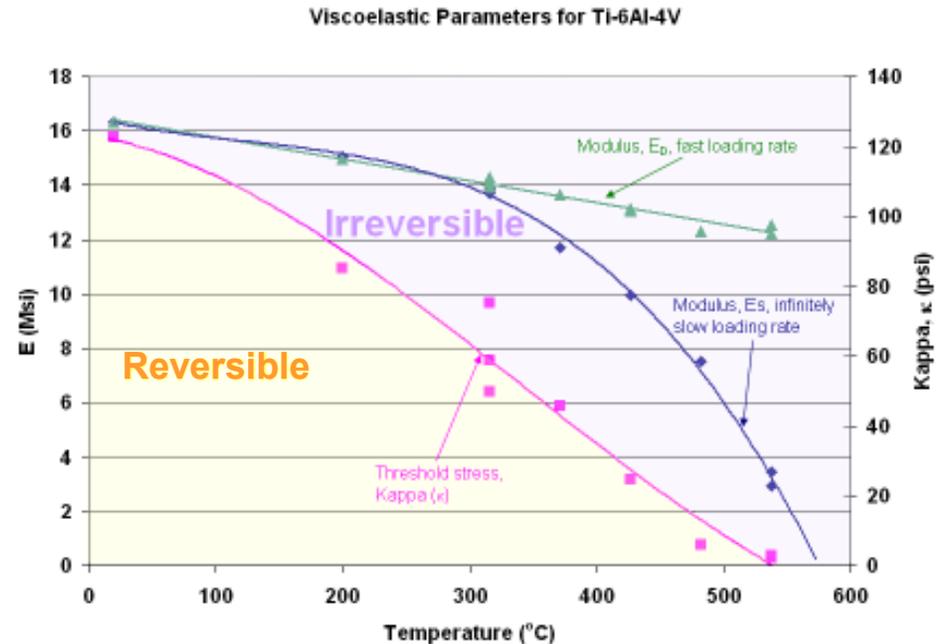




IVHM Impact: Prognosis

Predicting Thermomechanical Deformation Response of Advanced Composite Materials

- Micromechanics Analysis Code with Generalized Method of Cells (MAC/GMC).
- Enables progressive failure and damage analysis.



Impact in Space Applications, Academia, and Industry

- Impact in Exploration Systems Mission Directorate: Researchers were able to reconcile issues on Orion related to rate dependency of Ti-6-4 modulus at elevated temperatures which was a critical concern for the Orion project.
- Impact in Academia: Approximately 35 technical publications (15 journal papers) have been cited at least 100 times. 58% of the citations are by authors unaffiliated with the cited paper since 2003.
- Impact in Industry: Approximately 15 Universities and 28 industrial companies/government labs have signed software use agreements since 2003.



IVHM Impact: **Prognosis**

Prognostics Data Challenge

- Prognostic run-to-failure degradation datasets ranging over different operational and fault conditions made available to the research community.



Impact in Industry

- 60 active participants from academia and industry; dedicated session in PHM'08 conference; 4 invited papers.
- Data sets made available as benchmark data sets: Additional 63 downloads within the last month.
- Special issue of the *International Journal of PHM on Data-Driven Methods for Making Predictions* will use this data set to assess performance.



IVHM Task 4.3: DASHlink Collaborative Website

DASHlink | Home - Mozilla Firefox
File Edit View History Bookmarks Tools Help
https://dashlink.arc.nasa.gov/ Google

DASHlink
Discovery in Aeronautics Systems Health

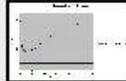
Topics Algorithms Data Members Discussion

DASHlink is a virtual laboratory for scientists and engineers to disseminate results and collaborate on research problems in health management technologies for aeronautics systems.

Explore...

Topics View and discuss analysis, results and projects.	Algorithms Find and download open source data analysis algorithms.	Data Browse and use publicly available datasets.	Members Meet the DASHlink community by viewing our member's profiles.
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Featured Topics

Created: 03/03/08 Activity: 05/30/08 ADAPT - An Electrical Power System testbed dmmcintosh scottpoll  Advanced Diagnostics and Prognostics Testbed (ADAPT) Project Lead: Scott Poll The Advanced Diagnostics and	Created: 03/27/08 Activity: 05/13/08 Computational Optimization w/the Distributed Computing Toolbox rmartin  The recent acquisition of high fidelity computational resources at NASA Ames allows for the use of a
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Upcoming Events:

- Conference on Intelligent Data Understanding (CIDU 2008)
Sep 9, 2008 - Sep 10, 2008
- Int'l Conference on Prognostics & Health Management (PHM 2008)
Oct 6, 2008 - Oct 9, 2008

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Add new Algorithm
Start new Discussion
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Inappropriate Content
Feedback

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