

Proceedings for Panel: PHM for Space Applications

Panel Summary

The planned use of manned and long term crewed space platforms, as well as quick to launch and reusable space vehicles, is increasing on a very accelerating rate. After the legacy NASA developed Space Shuttle and LEO ISS; among many things, there are near term NASA plans for: a Lunar Gateway station, a permanent lunar base, asteroid present, and Mars bases. Vehicles and platforms to accomplish these far reaching goals will include: crewed space and surface based stations and habitats; various types of launch, long range transportation, and orbit to surface vehicles; and all kinds of support subsystems and technologies. Beside NASA and other government directed organizations; commercial based entities are aggressively developing systems to achieve these same and additional space related goals. These associated commercial focused applications include space tourist to LEO, space based hotels, and resource mining. This panel will focus on issues and challenges associated with these applications; and how PHM capabilities can be applied to reduce risks, increase efficiencies, and ensure resilient sustainment of these vehicles, platforms, habitats, and systems.

Speakers/Presentations with links

1. Derek R. DeVries, (*Northrop Grumman Innovation Systems*)
2. Terry Haws, (*Northrop Grumman Innovation Systems*)
3. James A. Larkin, (*Aerojet Rocketdyne*)
4. Mark Walker, (*D2K Technologies*)

Summary of Key Issues from 20-30 minute open discussion

A good discussion from each panelist during their presentation on first why PHM is needed for space application and what technical approaches/methods can be used in space.

Questions from the Audience:

The questions asked were related to how a PHM system may be implemented, when and why a PHM system is needed. What methods may be used for focused on the questions asked. The questions asked were relative to how a system may be implemented and what technologies will be needed. i.e. sensing, data collection, analysis (Physic Based, Empirical, Big Data Analytics, Artificial Intelligence, etc.), reporting.

A specific focus for space is on the ability to capture early indications of a degradation in the materials, structure, control systems, etc. Given that when in space if a failure condition is happening there is a limited amount of time to react to protect the vehicle, habitat, station, or crew. So, as we venture father out into space the ability to react to change or adapt to a failing condition becomes more critical

and the ability to correct the fault are limited, so the earlier degradation is detected more options for crew protection and mission decisions based upon risk management.

Recommendations for Way Forward

Going forward, more panelist from the aerospace community will be asked to participate in the panel providing their expertise and views on when and what PHM for space applications are. The intention here is to provide information for the audience to help educate and inform them of what applications and methods are needed enabling the community to support the future in space.