



**Salt Lake City, Here We Come!**

**Join us in Salt Lake City at the Hilton hotel to rekindle old friendships and start new ones!**

**Optional Short Courses: October 28 – 29, 2023**

**Doctoral Symposium: October 29, 2023**

**Technical Program: October 30 – November 2, 2023**

**PHM2023 By the Numbers:**

- **2** Dedicated Short Courses (separate registration required)
- **4** Keynote Speakers
- **3** Free Tutorial Sessions:
  - » Assessment of Fault Severity Towards Prediction of the Remaining Useful Life
  - » Technical Language Processing
  - » Data-Driven Vibration Modeling
- **19** Technical Paper Sessions
- **12** Panel Sessions
- **1** Workshop on Industrial Applications of PHM
- **7** Technical Demonstrations and Product Showcases from Leading Organizations
- **5** Top Results of the Data Analysis Challenge in **2** Special Sessions
- **1** High-Quality Career Fair
- **15** Student Posters
- **∞** Networking Opportunities
- **1** Banquet Dinner, held at the Natural History Museum of Utah!



This will be a fully in-person event at the fabulous Hilton Salt Lake City Center. There are also two Short Courses available for an additional fee, running Saturday and Sunday, October 28–29. Details are available on website: <https://www.phmconference.org>.

Sponsor opportunities are still available. Please see our Sponsor website at <https://www.phmconference.org/sponsorship-and-recognition-opportunities>.

We hope that you will be able to join us this year and look forward to seeing you in the fall!

Scott Clements (Lockheed Martin) and Abhinav Saxena (GE Aerospace), chairs

[www.phmconference.org](https://www.phmconference.org)

[chairs@phmconference.org](mailto:chairs@phmconference.org)

# Agenda

Saturday, October 28, 2023

Location	PHM Fundamentals Short Course	PHM Data Analytics Short Course
Time	Salon 1	Seminar Theater
8:00 – 12:00	<b>PHM Fundamentals Short Course Day 1</b> <i>Separate Registration Required</i>	<b>PHM Data Analytics Short Course Day 1</b> <i>Separate Registration Required</i>
12:00 – 1:00	Included Lunch	
1:00 – 5:30	<b>PHM Fundamentals Short Course Day 1</b> <i>Separate Registration Required</i>	<b>PHM Data Analytics Short Course Day 1</b> <i>Separate Registration Required</i>



Sunday, October 29, 2023

Location	PHM Fundamentals SC	PHM Data Analytics SC	Doctoral Symposium
Time	Salon 1	Seminar Theater	Granite Conference Center
3PM – 5PM	Registration		
8:00 – 12:00	<b>PHM Fundamentals Short Course Day 2</b> <i>Separate Registration Required</i>	<b>PHM Data Analytics Short Course Day 2</b> <i>Separate Registration Required</i>	<b>Doctoral Symposium</b>
12:00 – 1:00	Included Lunch		Included Lunch
1:00 – 5:30	<b>PHM Fundamentals Short Course Day 2</b> <i>Separate Registration Required</i>	<b>PHM Data Analytics Short Course Day 2</b> <i>Separate Registration Required</i>	<b>Doctoral Symposium</b>



Monday, October 30, 2023

Location	Technical Paper Sessions	Technical Paper Sessions	Panel Sessions	Job Fair	Tech Demos
Time	Canyon A	Seminar Theater	Canyon B	Canyon C	Topaz
7:30AM – 4PM	Registration				
7:00 – 8:00	Continental Breakfast				Location: Ballroom Foyer
8:00 – 9:00	Opening Remarks <b>Keynote Speaker: Dr. Serdar Uckun (Novity)</b> “Generative AI and PHM – Transformation or Distraction?”				Location: Ballroom
9:00 – 9:15	Break				
9:15 – 10:45	Tutorial Session 1 <b>Assessment of Fault Severity towards Prediction of the Remaining Useful Life</b> Dr. Renata Klein (R.K. Diagnostics)				Location: Ballroom
10:45 – 11:00	Break				
11:00 – 12:30	Paper Session 1A: <b>Deep Learning Methods and Applications I</b>	<b>Workshop: Industrial Applications of PHM</b>	Panel Session 1: <b>Communicating PHM Model Performance to Customers</b>	Job Fair	<b>Product Showcase (Location: Ballroom)</b>
12:30 – 1:45	Lunch on your own				
1:45 – 3:15	Paper Session 2A: <b>PHM for Energy Systems</b>	Paper Session 2B: <b>Data Challenge Winners I</b>	Panel Session 2: <b>Predictive Maintenance in Aviation</b>	Job Fair	Tech Demo 1: MathWorks
3:15 – 3:30	Break				
3:30 – 5:00	Paper Session 3A: <b>Anomaly Detection and Diagnostics I</b>	Paper Session 3B: <b>Data Challenge Winners II</b>	Panel Session 3: <b>Are Standards Beneficial for AI in PHM?</b>	Job Fair	Tech Demo 2:
5:00 – 5:30	Free Time				
5:30 – 8:00	Cocktail Reception with Posters				Location: Ballroom Foyer
8:00 – 10:00	Student Social Event				Location: TBD



Tuesday, October 31, 2023

Location Time	Technical Paper Sessions	Technical Paper Sessions	Panel Sessions	Job Fair	Tech Demos
	Canyon A	Seminar Theater	Canyon B	Canyon C	Topaz
7:30AM – 4PM	Registration				
7:00 – 8:00	Continental Breakfast				Location: Ballroom Foyer
8:00 – 9:00	Opening Remarks <b>Keynote Speaker: Maj Gen H. Brent Baker, Sr., Ret. (PTC Worldwide Vertical Markets)</b> <b>“Closing the Digital Transformation (DX) Loop—Service Takes Its Appointed Place!”</b>				Location: Ballroom
9:00 – 9:15	Break				
9:15 – 10:45	Tutorial Session 2 <b>Technical Language Processing</b> Dr. Sarah Lukens ( <i>LMI</i> ) and Dr. Michael Sharp ( <i>NIST</i> )				Location: Ballroom
10:45 – 11:00	Break				
11:00 – 12:30	Paper Session 4A: <b>PHM for Bearing Health I</b>	Paper Session 4B: <b>PHM Robustness and Assurance Methods</b>	Panel Session 4: <b>Generative AI and ML for PHM</b>	Job Fair	Tech Demo 3: GE Aviation
12:30 – 1:45	Lunch on your own				
1:45 – 3:15	Paper Session 5A: <b>Physics-Informed Machine Learning I</b>	Paper Session 5B: <b>Anomaly Detection and Diagnostics II</b>	Panel Session 5: <b>PHM for Electronics</b>	Job Fair	Tech Demo 4: Siemens
3:15 – 3:30	Break				
3:30 – 5:00	Paper Session 6A: <b>Deep Learning Methods and Applications II</b>	Paper Session 6B: <b>Anomaly Detection and Diagnostics III + PHM Design I</b>	Panel Session 6: <b>PHM Successes and Lessons Learned</b>	Job Fair	Tech Demo 5
5:00 – 5:45	Free Time				
5:45	Busses Load for Banquet				
6:30 – 10:00	15th Annual Conference Banquet @ Natural History Museum of Utah				

Wednesday, November 1, 2023

Location Time	Technical Paper Sessions	Technical Paper Sessions	Panel Sessions	Job Fair	Tech Demos
	Canyon A	Seminar Theater	Canyon B	Canyon C	Topaz
7:30AM – 4PM	Registration				
7:00 – 8:00	Continental Breakfast				Location: Ballroom Foyer
8:00 – 9:00	Opening Remarks <b>Keynote Speaker: Dr. Eric Lindgren (AFRL)</b> <b>“Perspectives on Prognostic Health Management in Support of Structural Integrity”</b>				Location: Ballroom
9:00 – 9:15	Break				
9:15 – 10:45	Tutorial Session 3 <b>Data-Driven Vibration Modeling</b> Dr. Manu Krishnan ( <i>Joby Aviation</i> )				Location: Ballroom
10:45 – 11:00	Break				
11:00 – 12:30	Paper Session 7A: <b>Deep Learning Methods and Applications III + PHM Design II</b>	Paper Session 7B: <b>Anomaly Detection and Diagnostics IV</b>	Panel Session 7: <b>Autonomous Systems and PHM</b>	Job Fair	Tech Demo 6: MathWorks
12:30 – 2:00	Conference Lunch and Technical Program Awards <b>Keynote Speaker: MG Dave Bryan, Ret. (End to End Enterprise Solutions)</b> <b>“Cyber-Security: Exploring Historical Background, Current Issues, Challenges, and the Future Way Forward”</b>				Location: Ballroom
2:00 – 3:30	Paper Session 8A: <b>Deep Learning Methods and Applications IV</b>	Paper Session 8B: <b>Data Generation and Processing for PHM</b>	Panel Session 8: <b>Education and Professional Development in PHM</b>	Job Fair	Tech Demo 7: Siemens
3:30 – 3:45	Break				
3:45 – 5:15	Paper Session 9A: <b>PHM for Bearing Health II</b>	Paper Session 9B: <b>Physics-Informed Machine Learning II + Technical Language Processing I</b>	Panel Session 9: <b>Moving Towards Cybersecurity and PHM Synchronicity</b>	Job Fair	Tech Demo 8: GTC
5:15 – 6:00	Free Time				
6:00 – 9:00	Appreciation Dinner (Invitation Only)				Location: Caff� Molise

# Agenda

Thursday, November 2, 2023

Location	Technical Paper Sessions	Technical Paper Sessions	Panel Sessions	Planning Sessions
Time	Canyon A	Seminar Theater	Canyon B	Canyon C
7:30AM – 12PM	Registration			
7:00 – 8:00	Continental Breakfast			Location: Ballroom Foyer
8:00 – 8:45	Opening Remarks Mentor/Mentee Event			Location: Ballroom
8:45 – 9:00	Break			
9:00 – 10:30	Paper Session 10A: PHM for Bearing Health III	Paper Session 10B: Technical Language Processing II + Anomaly Detection and Diagnostics V	Panel Session 10: Nuclear Power Health Monitoring	PHM2024 Planning Meeting Volunteers Welcome!
10:30 – 10:45	Break			
10:45 – 12:15	Paper Session 11A: Remaining Useful Life Estimation Methods	Paper Session 11B: PHM Design III	Panel Session 11: Space Applications	Panel Session 12 (Loc: Ballroom): Smart Factory Enabling Technologies
12:15 – 1:00	Reserved	Closing Remarks	Reserved	Reserved

## Optional Online Short Courses

For more information contact  
[shortcourse@phmconference.org](mailto:shortcourse@phmconference.org)  
 Separate Registration Required

### Short Course 1: PHM Fundamentals – From Monitoring and Sensing to Fault Diagnosis, Failure Prognosis, and Case Studies

October 28 – 29, 8:00 – 5:30, Salon 1

Course Leaders: *Karl Reichard* (Penn State) and *Jeff Bird* (TECnos)

Course Presenters: Specialists using proven PHM Society curriculum, case studies, and mini-workshops, including *Karl Reichard* (Penn State), *Abhinav Saxena* (GE), *Jose Celaya* (SLB), and *Jeff Bird* (TECnos)

Course Administrator: *Jeff Bird* (TECnos)

#### Overview

This introductory course offered regularly at PHM conferences will be taught by recognized international experts in the PHM field and will cover the current state of the art in PHM technologies, sensors and sensing strategies, data mining tools, CBM+ technologies, novel diagnostic and prognostic algorithms as well as a diverse array of application examples/case studies. It is addressed to engineers, scientists, operations managers, educators, small business principals, and system designers interested to learn how these emerging technologies can impact their work environment. Through a lecture (with Q&A), networking and workshop format with several specialist experts, you will:

1. Establish a baseline for defining the extent and capabilities of PHM, specifically needs and organization
2. Identify specific details of PHM Applications (metrics, sensors, cost benefits, reliability) and PHM Methods (diagnostics, prognostics, data

driven methods and uncertainty)

3. Examine case studies of PHM applications across diverse domains to identify solutions and impacts
4. Plan a PHM application in two mini workshop settings with expert group leaders
5. Identify issues and needs and a way forward including Continuing Professional Development

Topics include (case study or workshop sessions):

- Introduction to PHM
- Deriving Requirements for PHM
- PHM Performance Metrics
- Diagnostics Methods
- Case Study for Requirements/Metrics
- Case Study for Diagnostics
- Prognostics Methods
- Data Analytics Methods
- Prognostics Case Study
- Sensors and Data Processing
- Sensors and Sensor Strategies
- Data – Case Study Workshop
- CBM+ and IVHM Technologies
- PHM Cost Benefit Analysis
- Plenary – Issues and Needs
- Analysis – Case Study Workshop
- Fielded Systems Case Studies – 1
- Fielded Systems Case Studies – 2
- Way forward

### Short Course 2: Analytics for PHM

October 28 – 29, 8:00 – 5:30, Seminar Theater

Course Presenter: *Neil Eklund* (Oak Grove Analytics)

Course Administrator: *Jeff Bird* (TECnos)

#### Overview

This course is intended for engineers, scientists, and managers who are interested in data-driven methods for asset health management. You will learn how to identify potential data-driven projects, visualize data,

screen data, construct and select appropriate features, build models of assets from data, evaluate and select models, and deploy asset monitoring systems. By the end of the course, you will have learned the essential skills of processing, manipulating, and analyzing data of various types, creating advanced visualizations, detecting anomalous behavior, diagnosing faults, and estimating remaining useful life. Note that this course is an advanced course with only a brief, high-level overview of PHM presented – students are expected to know the basics of PHM already. New practitioners are encouraged to take the fundamentals course or contact the course leader to examine their background and skills.

The course is about two-thirds lecture and an optional one-third hands-on lab. Students who elect to take the lab will be expected to bring a laptop to use the Colab application developed for the course (see below).

Topics include (most with embedded case studies and examples):

- Overview of Data-Driven PHM
- Review of Fundamental Statistics
- Data Visualization
- Machine Learning - Introduction and Concepts
- Classification
- Regression
- Intro to Neural Networks
- Hands-on Lab
- Feature Selection
- Characterizing Performance
- Model Selection
- Anomaly Detection
- Deep Learning I
- Deep Learning II
- Applications
- Practical matters
- Hands-on Lab

We will go around the room on the first day to have short introductions from each participant to know their name, organization, and what they would like to get out of the course. We usually have a great mix of organizations and nations!! Please raise your hand for clarification during the talks. Provocative or wider domain questions are welcome but may be gathered for discussion in a plenary segment. Paper copies of the slides will be available when you arrive the first morning. No soft copies are provided.

Technical Labs: The optional (but encouraged) labs correspond to some of the big topics of the lectures. The labs will be on Google's Colab, which is a free notebook environment (although you do need a Google account) that runs entirely in the cloud. Colab will allow you to run all of the necessary Python libraries.

If you intend to participate in the lab portion of the course, we will send you a link with the code and data to verify that you are able to open and execute it before the start of the course. Data, code, and libraries are already in the Colab doc so you could you will be able to try them out to tweak and explore the tools and results.

---

## Keynote Speakers

---

### Keynote 1: Generative AI and PHM – Transformation or Distraction?

Monday, Oct. 30, 2023, 8:00 – 9:00,  
Ballroom

Presenter: *Dr. Serdar Uckun* (Novity)

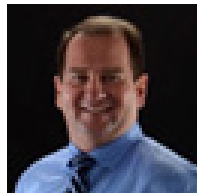


Generative AI is everywhere. Since the public release of ChatGPT, AI has become a global fascination. While most Generative AI applications are a natural evolution of natural language processing technology, there is more to Generative AI beyond answering complex questions, writing software code, and translating documents. Generative AI is already making huge strides in drug discovery, creating music and art, and engaging humans in natural conversation. The PHM community is watching this space and wondering whether Generative AI is going to lead to a transformation in PHM or will remain a distraction. This talk will cover the basics of Generative AI technology, provide insights into developments we are likely to see over the next few years and speculate on what Generative AI means for PHM.

### Keynote 2: Closing the Digital Transformation (DX) Loop—Service Takes Its Appointed Place!

Tuesday, Oct. 31, 2023, 8:00 – 9:00,  
Ballroom

Presenter: *Maj Gen H. Brent Baker, Sr., Ret.* (PTC Worldwide Vertical Markets)



OEMs are looking to take more advantage of the in-service support value chain. A “New” program takes 2 to 10 years to design but is usually in service for 30 to 40 years. The key component is the in-service configuration management capability and the closed loop information sharing in order to be able to provide optimization services such as contextualized digital work instructions, dynamic work scope definition, Condition-Based Maintenance/Predictive Maintenance, dynamic resource allocation, fleet status monitoring, etc. Advanced spare parts planning solutions will take advantage of the approach for a more automated way to gather information for demand and LLP forecasting. Service now takes its appointed place in the DX Loop.

### Keynote 3: Perspectives on Prognostic Health Management in Support of Structural Integrity

Wednesday, Nov. 1, 2023, 8:00 – 9:00,  
Ballroom



Presenter: *Dr. Eric Lindgren (AFRL)*

The management of structural integrity, or safety, of US Air Force (USAF) aircraft structures is through the Aircraft Structural Integrity Program (ASIP) as described by MIL STD 1530Dc1 and for USAF propulsion systems through the Propulsion Systems Integrity Process (PSIP) as described in MIL STD 3024. Both documents include a prognostic element in the understanding of life management when addressing fatigue. To accomplish these goals, there is extensive use of digital engineering capabilities. The ASIP uses damage tolerance which relies on predictive capabilities for fatigue from fracture mechanics when integrating individual aircraft tracking (IAT). To increase the accuracy of the predictive capability, the as-built, as-maintained, as-repaired, as-modified, and as-used history of each aircraft is captured. This includes flaws detected and repaired using nondestructive evaluation (NDE) capabilities. The integrated information can be captured in a digital representation of each aircraft, aka its digital twin. To be thorough, these representations should include the prognostic models that enable future states of the aircraft to be anticipated as a function of their use. This enables predictive maintenance and related condition-based maintenance activities. The presentation describes several representative capabilities that use the digital environment to assist in the management of system health, plus areas for improvements and refinements at research/development and engineering levels. This includes discussion of technical capabilities that can be refined, or require additional improvements, without a focus on any specific weapons system. Representative applications of advanced data diagnostics are included as well as their future potential for additional integration into life management processes. The potential for corrosion management and predictive life management of polymer matrix composite systems is addressed, including recent progress and areas that require additional development. This includes new NDE-based methods to enhance life management through characterization of flaws. This overview includes a comparison of USAF life management processes as prescribed by ASIP and to the life management processes used by the US Navy and civilian aircraft.

### Keynote 4: Cyber-Security: Exploring Historical Background, Current Issues, Challenges, and the Future Way Forward

Wednesday, Nov. 1, 2023, 1:00 – 2:00,  
Ballroom



Presenter: *MG Dave Bryan, Ret. (Strategic Advisor and Chairman of the Board of End to End Enterprise Solutions (E3S))*

General Dave Bryan (US Army Ret) will share wisdom gleaned from his dual-hat role as the Vice Director of the Defense Information Systems Agency (DISA), and the first Commander of the DOD Joint Task Force for Computer/Global Network Operations, the predecessor to today's US Cyber Command. His keynote will cover the history of Cybersecurity, Prognostics and AI, and examine the nexus of these three areas in the future, painting a picture of what he believes that future would like.

---

## Doctoral Symposium

---

Sunday, October 29, 2023, 8:00 – 5:30, Granite Conference Center

The Doctoral Symposium provides an opportunity for graduate students to present their research interests and plans at a formative stage in their research. The students will receive structured guidance from a panel of distinguished researchers as well as comments from conference participants and fellow students in a collegial setting. The PHM Society Doctoral Symposium will be held as a workshop on the first day of the conference.

---

## Tutorials

---

One of the unique features of the PHM conferences is free technical tutorials on various topics in health management taught by industry experts. As educational events tutorials provide a comprehensive introduction to the state-of-the-art in the tutorial's topic. Proposed tutorials address the interests of a varied audience: beginners, developers, designers, researchers, practitioners, and decision-makers who wish to learn a given aspect of prognostic health management. Tutorials will focus both on theoretical aspects as well as industrial applications of prognostics. These tutorials reach a good balance between the topic coverage and its relevance to the community. This year's tutorials cover a range of topics and are presented by subject matter experts with a deep understanding of the domain.



### **Tutorial Session 1: Assessment of Fault Severity Towards Prediction of the Remaining Useful Life**

*Monday, October 30, 2023, 9:15 – 10:45, Ballroom*

*Presenter: Dr. Renata Klein (R.K. Diagnostics)*

*Description:* The main challenge of PHM is to predict the remaining useful life of components (RUL). This is a three-step process. The first step is the detection of the fault, including the identification of the failure mode. The second step is the assessment of the fault severity. The third step is the prediction of the RUL. Predicting the RUL requires a good understanding of the fault propagation mechanism for the specific failure mode, an assessment of the fault severity trend, and a definition of the critical point that marks the end of life (the critical fault severity). The tutorial will focus on the second step – the assessment of fault severity, in the context of rotating machines. For rotating components, the assessment of the fault severity and the determination of the critical severity are extremely challenging.

Two main approaches are mostly investigated. The first approach involves techniques that rely on the physical understanding of the changes in the vibration signature, with respect to the fault severity. The second approach encompasses a range of data-driven methods, including statistical modeling, supervised learning, and unsupervised learning. Lately, some studies have proposed hybrid methods that take advantage of the strengths of both approaches. The tutorial will present and compare the different approaches and their possible application in the research of PHM, focusing on rotating components. The presentation will explain and illustrate the important role of physical models in different research phases, the development of new Condition Indicators that can bring essential enlightenment to the task of prognostics in mechanical systems, as well as the possibilities to incorporate machine learning algorithms in hybrid methods.

### **Tutorial Session 2: Technical Language Processing**

*Tuesday, October 31, 2023, 9:15 – 10:45, Ballroom*

*Presenter: Dr. Sarah Lukens (LMI)*

*Description:* Technical Language is highly contextual communications found in industry, academia, and other scientific domains where terms may have very different uses or implications than more common natural language. This tutorial introduces participants to Technical Language Processing (TLP), an engineering-oriented approach that leverages AI tools, including Natural Language Processing (NLP), for effective processing of technical language data. Central components of TLP will be covered, starting with engineering use cases related to Prognostics and Health Management (PHM). The tutorial will provide an overview of fundamental concepts from mainstream NLP, including NLP pipelines, pre-processing techniques, and word

representation methods with a clear emphasis on the applications and risks of using them in TLP. This tutorial will also highlight existing tools and procedures that aid in cleaning, processing, and analyzing information contained within technical documents of various sizes. We will conclude with a TLP Q&A addressing successes, challenges, and next steps for the community.

### **Tutorial Session 3: Data-Driven Vibration Modeling**

*Wednesday, November 1, 2023, 9:15 – 10:45, Ballroom*

*Presenter: Dr. Manu Krishnan (Joby Aviation)*

*Description:* Developing deep learning algorithms for predictive maintenance of industrial systems is a growing trend in numerous application fields. Whereas applied research methods have been rapidly advancing, implementations in commercial systems are still lagging behind. One of the main reasons for this delay is the fact that most methodological advances have been focusing on the development of data-driven algorithms for fault detection, diagnosis, or prognosis, ignoring some of the crucial aspects that are required for scaling these algorithms to large fleets of multi-component heterogeneous machines under varying operating conditions, and making sure that their implementation is technically feasible.

In this tutorial, we will elaborate on some of these aspects and discuss possible approaches to address them. We will provide the background to data analytical techniques that enable the scalable deployment of deep learning algorithms in commercial machine fleets. Some examples are transfer learning, fleet-level algorithms, physics-informed deep learning, and uncertainty quantification. We will demonstrate these general concepts using concrete use-cases that apply them to operational data from commercial machine fleets.

---

## **Workshop and Panel Sessions**

---

### **Workshop: Prognostics in the Process Industries: Success Stories or Empty Promises?**

*Monday, Oct. 30, 11:00 – 12:30, Room: Seminar Theater*

*Session Chair: Daniel Nelson (Novity)*

*Description:* Although the concept of predictive maintenance has been around for decades, by most accounts adoption within the process industries appears to be much slower than within other industries. In particular, the application of prognostics as an enabling technology for predictive maintenance is not widespread. This panel will aim to clarify the place of prognostics within the context of predictive maintenance, as well as address the questions regarding adoption of predictive maintenance. In particular, this panel will cover the following topics:

- Challenges with transitioning to PdM from legacy maintenance programs

- Best practices for maximizing PdM value in the process industries
- Technology gaps and horizons

**Panelists:**

Matthew Daigle (Novity)  
 José Celaya (SLB)  
 Ross Mahler (Moxa Americas)

**Panel Session 1: Communicating PHM Model Performance to Customers**

Monday, Oct. 30, 11:00 – 12:30, Room: Canyon B  
 Session Chair: Sarah Lukens (LMI)

*Description:* Formal approaches for reporting model performance can be challenged when applied to PHM models for a variety of reasons. Application specific factors such as characteristics of PHM data (e.g., class imbalance) combined with the highly technical nature of models may lead to performance reports which can be difficult to explain to the end user. Further, the relationship between key decision-making factors such as economic considerations, deployment requirements, etc. may not be directly spelled out when reporting model performance. This panel will continue a discussion from the tutorial at the 2022 PHM Society conference: “Evaluating Machine Learning Models for PHM: We’re doing it wrong!” Formal textbook model performance, common customer requirements and practical challenges such as data characteristics will be discussed.

**Panelists:**

Jesse Williams (Global Technologies)  
 Peng Liu (JMP)  
 Katarina Vuckovic (Collins Aerospace)  
 Dimitry Belov (SLB)

**Panel Session 2: Predictive Maintenance in Aviation**

Monday, Oct. 30, 1:45 – 3:15, Room: Canyon B  
 Session Chair: Chris Teubert (NASA)

*Description:* The DoE estimated that a well-designed PdM program can reduce maintenance costs by 30%. Maintenance costs currently account for around 13% of total airline operation costs. The US Congress identified that “If performed effectively, predictive maintenance can reduce... system downtime, ensure adequate supply of needed parts, and decrease costs.” Army and Navy officials have identified predictive maintenance technologies as possibly preventing accidents on aircraft such as the AH-64 Apache and the F/A-18 Super Hornet and in trucking, preventative maintenance has reduced breakdowns by 20% and maintenance costs by \$2-12.5k per truck per year. NASA is working on a whitepaper on the challenges preventing the full adoption of PdM in aviation and is considering starting a body of work around this.

**Panelists:**

Darren Macer (Boeing)  
 Justin Sindewald (United Airlines)  
 Rhonda Walthall (Collins Aerospace)

**Panel Session 3: Are Standards Beneficial for AI in PHM?**

Monday, Oct. 30, 3:30 – 5:00, Room: Canyon B  
 Session Chairs: Greg Vogl (NIST) and Jeff Bird (TECNOS)

*Description:* Did you know that there are over 300 standards for artificial intelligence (AI) that are being developed or have been published? The intended domains include healthcare, energy, finance, manufacturing, and transportation, while the applications include computer vision and autonomous systems among others. This panel will provide information for audience members interested in learning about these standards that could be applicable to their goals, with perspectives and experiences by domain experts about standardizing AI. The panel will conclude with a facilitated discussion with the audience to explore the challenges, synergies, and opportunities of standards for AI and ideas for leadership by the PHM Society community.

**Panelists:**

Peter Bajcsy (NIST)  
 Kai Goebel (SRI International)  
 Neil Eklund (Oak Grove Analytics)  
 Xiaodong Jia (University of Cincinnati)

**Panel Session 4: Generative AI and ML for PHM**

Tuesday, Oct. 31, 11:00 – 12:30, Room: Canyon B  
 Session Chairs: Asma Ali (GE Digital) and Sarah Lukens (LMI)

*Description:* The emergence of ChatGPT has sparked interest in its potential impact on Prognostics and Health Management (PHM). This panel aims to explore the implications of ChatGPT for PHM, including the associated risks, how industrial companies are adopting it, and the benefits they’re experiencing. As ChatGPT gains popularity in industrial settings, understanding how it fits into PHM workflows becomes crucial, particularly concerning its capacity to optimize predictive maintenance paradigms and amplify operational efficiencies. While reports suggest productivity improvements across various industries, the exact extent and mechanisms of these enhancements remain unclear. This panel will bring together PHM stakeholders from academia and industry, and discuss topics related to integration of ChatGPT into PHM.

**Panelists:**

Kai Goebel (SRI International)  
 Karl Reichard (Pennsylvania State University)  
 Olympia Brikis (Siemens)  
 Mark Roboff (SkyThread)



### **Panel Session 5: PHM for Electronics: Electronics PHM Standards Development Working Groups and Collaboration Between IEEE and SAE**

Tuesday, Oct. 31, 1:45 – 3:15, Room: Canyon B  
Session Chairs: **Lou Gullo** (Northrop Grumman)

*Description:* The mobility sector has undergone an explosion in terms of electrification, which has brought up the need to develop PHM technologies related to power electronic devices, energy storage systems, and power transmission and usage. There is a need to explore the use of PHM in making software systems more secure and resilient.

The world has seen the confluence of AI and ML, big data analytics, smart sensors supplemented by internet of things (IOT) technologies, and wireless communications technologies such as 5G and beyond networks. There is a need for a secure and resilience framework involving dev/ops with PHM to ensure continuous, uninterrupted, and reliable system operations. In this panel we plan to explore the concepts of predictive analytics, reliability, maintainability, availability, resilience, security, and system safety using a holistic PHM end to end architecture with machine learning and data management operations (DataOps) and the value of creating standards that provide a roadmap for future direction.

This panel will focus on Electronics PHM Standards Development, and the coordination between two leading SDOs – IEEE and SAE – in the development of these standards. IEEE is developing a new PHM standard, IEEE P1856.1 – Recommended Practice for Development and Implementation of Prognostic and Health Management (PHM) Systems In Accordance with IEEE-1856 – which needs to be reconciled with the work of SAE committees such as E-32, HM-1, and G-34.

#### *Panelists:*

**Sony Matthew** (SLB)  
**Rex Sallade** (Lockheed Martin (retired))  
**Kenney Crooks** (Northrop Grumman)

### **Panel Session 6: A Fireside Chat: PHM Successes and Lessons Learned**

Tuesday, Oct. 31, 3:30 – 5:00, Room: Canyon B  
Session Chair: **Andy Hess** (Hess PHM Group) and **Derek Devries** (Northrop Grumman)

*Description:* A Fireside Chat – Experience and Lessons Learned over the Multiple Eras of PHM Development and Implementation

This panel is made up of several “seasoned” experts who have been developing and implementing PHM related capabilities and technologies for a great number of years. This panel will use their experiences and stories to explore the issues, barriers, and lessons learned that have evolved across the many eras of PHM related

activities including: requirements generation, capability benefits, ROI, justifications; development; validation & verification; policies; expanding applications; integration: implementation; operations, sustainment; enterprise-wide perspectives

#### *Panelists:*

**Mark A. Mazarek** (Boeing Global)  
**Frank Zahiri** (USAF AFMC)  
**David Peterson** (Siemens)

### **Panel Session 7: Autonomous Systems and PHM**

Wednesday, Nov. 1, 11:00 – 12:30, Room: Canyon B  
Session Chair: **Karl Reichard** (Pennsylvania State University)

*Description:* Autonomous and unmanned systems are becoming more common in a range of civilian and defense applications. Examples include self-driving cars, mobile robots, military vehicles, and commercial transportation. Many unmanned systems are based on human-operated platforms augmented with drive-by-wire (B) and autonomy (A) kits. For operators of fleets of autonomous vehicles, the requirements and benefits of PHM are similar to those for their human-operated equivalents. However, from a sustainment standpoint, there may be additional requirements and benefits for PHM that differ from human-operated platforms. In addition, autonomous platforms have additional sensors, actuators, and software systems. This panel will explore how requirements for PHM and the implementation of PHM differ from human-operated and autonomous platforms.

#### *Panelists:*

**Ed Baumann** (Trident Systems)  
**Justinian Rosca** (Siemens)  
**Kai Goebel** (SRI International)

### **Panel Session 8: Education and Professional Development in PHM**

Wednesday, Nov. 1, 1:45 – 3:15, Room: Canyon B  
Session Chair: **Jeff Bird** (TECnos) and **Nancy Madge** (TECnos)

*Description:* The PHM Society is dedicated to promoting the development, growth, and recognition of PHM as an engineering discipline and to supporting PHM education by developing standard teaching curricula in the field. The society has developed and regularly offered two courses to the community: PHM Fundamentals and Case Studies, and Analytics for PHM. It has proposed an EPD (“one-stop resource”) portal, PHM taxonomy, and PHM Professional Development Guidelines. This panel session with the full engagement of the audience aims to: summarize existing PHM educational resources; identify education and professional development needs; and prioritize new niche opportunities for society with diversity and inclusion. From this new knowledge and insights, the PHM Society will

augment the EPD portal on its website with EPD resources, a prioritized list of new initiatives, and possibly create an enhanced discussion and debate area dedicated to related topics.

*Panelists:*

**Derek DeVries** (*Northrop Grumman*)

**Peter Sandborn** (*CALCE*)

**Panel Session 9: Moving Towards Cybersecurity and PHM Synchronicity**

Wednesday, Nov. 1, 3:30 – 5:00, Room: Canyon B

*Session Chair:* **Mark Walker** (*End to End Enterprise Solutions*)

*Description:* This panel will discuss perspectives on how PHM and cybersecurity relate to and depend on each other. Main goal is to initiate discussion on the synchronous roles of Cybersecurity and PHM, and the value they add together with proactive and practical inputs. To discuss how coordinated action can lead to greater precision and higher efficiency in resolution, thus impacting the final service output for the customer.

*Panelists:*

**Bruno Paes Leao** (*Siemens*)

**MG Dave Bryan** (*End to End Enterprise Solutions*)

**Desmond Haynes** (*GH Konnections*)

**Panel Session 10: Nuclear Power Health Monitoring**

Thursday, Nov. 2, 9:00 – 10:30, Room: Canyon B

*Session Chair:* **Vivek Agarwal** (*Idaho National Laboratory*)

*Description:* The operating fleet of nuclear power plants (NPPs) in the United States is the largest source of clean energy. Ensuring their long-term economical and safe operation is essential for the net-zero vision of the nation. Prognostics and health management (PHM) approaches are applied to enhance the situational awareness of NPP's structures, systems, and components and achieve cost savings by automating several of the cost-prohibitive operation and maintenance activities. The application of PHM in the nuclear industry takes advantage of advancements in several technologies that include (but are not limited to) sensors, communications, machine learning, and artificial intelligence. Seamless integration of these technologies with existing infrastructure at NPPs presents several challenges that need to be understood and addressed, enabling low operating costs, high reliability and safety, and flexible plant operation and generation. The application of PHM and technologies is not just restricted to operating NPPs, but is also expected to benefit operation and maintenance activities for advanced reactors.

*Panelists:*

**Bruce Hallbert** (*Idaho National Lab*)

**Jeffrey Clark** (*Constellation*)

**Syed Alam** (*University of Chicago – Urbana Champaign*)

**Panel Session 11: Space Applications**

Thursday, Nov. 2, 10:45 – 12:15, Room: Canyon B

*Session Chair:* **Derek Devries** (*Northrop Grumman*) and **Andy Hess** (*Hess PHM Group*)

*Description:* The planned use of manned and long-term crewed space platforms, as well as quick-to-launch and reusable space vehicles, is increasing at a very accelerating rate. After the legacy NASA developed the Space Shuttle and LEO ISS; among many things, there are near-term NASA plans for a lunar Gateway station, a permanent lunar base, asteroid presence, 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. Besides NASA, DoD, and other government-directed organizations; commercial-based entities are aggressively developing systems to achieve these same and additional space-related goals. These commercial-focused applications include space tourists to space and LEO, space-based hotels, and lunar and deep space 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.

*Panelists:*

**Sudipto Ghoshal** (*QSI*)

**Heath Dewey** (*Northrop Grumman*)

**Wolfgang Fink** (*University of Arizona*)

**Panel Session 12: Smart Factory Enabling Technologies**

Thursday, Nov. 2, 10:45 – 12:15, Room: Ballroom

*Session Chair:* **Frank Zahiri** (*USAF AFMC*)

*Description:* The integrated network of technologies, known as Smart Manufacturing, brings intelligence to the operation of manufacturing systems. The fusion of a multiplicity of measurement technologies including distributed fiber optic sensing provides multipoint profiles of parameters such as temperature, dynamic strain and pressure distributions and defect locations provides enhanced awareness of manufacturing state. Then novel technologies for optimum planning and scheduling, data analytics, Deep Learning, Artificial Intelligence, data/image processing, process integrity management via tools of data mining, incipient failure diagnosis and prognosis, resilient and reconfigurable

control techniques seeking to maintain the process' operational integrity even in the presence of fault/failure modes constitute the technical underpinnings for smart manufacturing. As information becomes easier to obtain and share, management personnel can leverage advances in information, computing, and communication technologies to solve problems, maximize the talent of the workforce and minimize the time an asset spends on the manufacturing floor.

**Panelists:**

James Hill (*Aging Aircraft Solutions*)

Rob Andes (*Shipcom Wireless Inc.*)

Matthew Bell (*Point Pro Inc.*)

William Price (*IFOS Inc.*)

---

## Technical Paper Sessions

---

High-quality, peer-reviewed technical papers from academic and industrial research will be presented. The papers can be categorized as analysis methods, asset-specific algorithms, prototype implementations, fielded systems, and business case analysis.

**Paper Session 1A: Deep Learning Methods and Applications I**

Mon., Oct. 30, 11:00 – 12:30, Room: Canyon A

**Panel Session 2A: PHM for Energy Systems**

Mon., Oct. 30, 1:45 – 3:15, Room: Canyon A

**Panel Session 2B: Data Challenge Winners I**

Mon., Oct. 30, 1:45 – 3:15, Room: Seminar Theater

**Panel Session 3A: Anomaly Detection and Diagnostics I**

Mon., Oct. 30, 3:30 – 5:00, Room: Canyon B

**Panel Session 3B: Data Challenge Winners II**

Mon., Oct. 30, 3:30 – 5:00, Room: Seminar Theater

**Paper Session 4A: PHM for Bearing Health I**

Tues., Oct. 31, 11:00 – 12:30, Room: Canyon A

**Paper Session 4B: PHM Robustness and Assurance Methods**

Tues., Oct. 31, 11:00 – 12:30, Room: Seminar Theater

**Panel Session 5A: Physics-Informed Machine Learning I**

Tues., Oct. 31, 1:45 – 3:15, Room: Canyon A

**Panel Session 5B: Anomaly Detection and Diagnostics II**

Tues., Oct. 31, 1:45 – 3:15, Room: Seminar Theater

**Panel Session 6A: Deep Learning Methods and Applications II**

Tues., Oct. 31, 3:30 – 5:00, Room: Canyon B

**Panel Session 6B: Anomaly Detection and Diagnostics III + PHM Design I**

Tues., Oct. 31, 3:30 – 5:00, Room: Seminar Theater

**Paper Session 7A: Deep Learning Methods and Applications III + PHM Design II**

Wed., Nov. 1, 11:00 – 12:30, Room: Canyon A

**Paper Session 7B: Anomaly Detection and Diagnostics IV**

Wed., Nov. 1, 11:00 – 12:30, Room: Seminar Theater

**Panel Session 8A: Deep Learning Methods and Applications IV**

Wed., Nov. 1, 1:45 – 3:15, Room: Canyon A

**Panel Session 8B: Data Generation and Processing for PHM**

Wed., Nov. 1, 1:45 – 3:15, Room: Seminar Theater

**Panel Session 9A: PHM for Bearing Health II**

Wed., Nov. 1, 3:30 – 5:00, Room: Canyon B

**Panel Session 9B: Physics-Informed Machine Learning II + Technical Language Processing I**

Wed., Nov. 1, 3:30 – 5:00, Room: Seminar Theater

**Paper Session 10A: PHM for Bearing Health III**

Thurs., Nov. 2, 9:00 – 10:30, Room: Canyon A

**Paper Session 10B: Technical Language Processing II + Anomaly Detection and Diagnostics V**

Thurs., Nov. 2, 9:00 – 10:30, Room: Seminar Theater

**Panel Session 11A: Remaining Useful Life Estimation Methods**

Thurs., Nov. 2, 10:45 – 12:15, Room: Canyon A

**Panel Session 11B: PHM Design III**

Thurs., Nov. 2, 10:45 – 12:15, Room: Seminar Theater

---

## Technology Demonstrations

---

The PHM Society invites our conference sponsors to show off their diagnostic and prognostic engineering approaches through PHM Technology Demonstrations. The concept of the demonstrations is to offer a true “hands-on” learning experience for attendees. Multiple demonstrations will be given as brief tutorials to small groups. Each demo will last 30 to 60 minutes, where attendees will be encouraged to actively participate.

---

## Product Showcases

---

Since 2018 the PHM Society has been offering Sponsors a unique opportunity: the Product Showcase—where presenters may take advantage of a unique platform to advertise company products and services in a focused environment. The intent is to generate audience interest for follow-up exchange.

The Product Showcase sessions will be comprised of a series of short marketing presentations. The communication will be one-way, where all questions/answers are reserved for off-line. Audiences will enjoy this approach as companies strive to make significant first impressions during a condensed window of time.



---

Thank You to Our Sponsors!

---

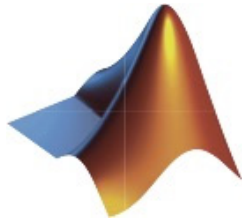


**Collins Aerospace**  
An **RTX** Business

**SIEMENS**



**GE Aerospace**



**MathWorks®**

**[ ] END TO END**  
*ENTERPRISE SOLUTIONS*

**NORTHROP  
GRUMMAN**



**KBR**

**QSI**