

PHM 2017

**9th Annual Conference of the
Prognostics and Health Management Society**



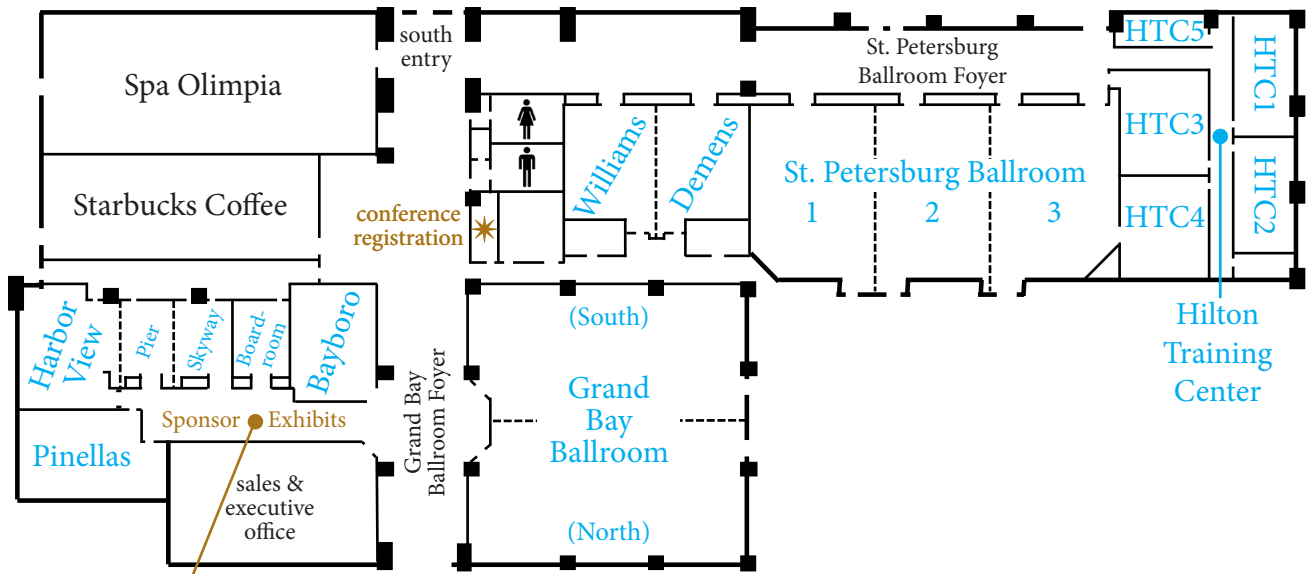
**St. Petersburg, FL
October 2 – 5, 2017
www.phmconference.org**



www.phmsociety.org



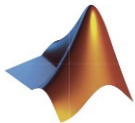
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The PHM Society

For years, the field of PHM was represented under a variety of banners, including aerospace, reliability, failure analysis and prevention, mechanical engineering, and others. PHM is broader than any single field of study. The PHM Society was established to unite the diverse PHM community and to establish PHM as a legitimate scientific and engineering discipline that draws from electrical, mechanical, civil, and chemical engineering, computer and materials science, reliability, test and measurement, artificial intelligence, physics, and economics. We invite you to establish PHM as a meta-discipline that synergizes these fields.

PHM Society membership is free and entitles you to full access to papers, tutorials and proceedings—join or update your profile today!

Get details of the Conference using the free Whova mobile app on your phone or tablet. See page 11 for details.

Welcome to St. Petersburg!

Welcome to beautiful St. Petersburg, for the 2017 Annual Conference of the Prognostics and Health Management Society. At this, the 9th domestic conference of the PHM Society, we are delighted to celebrate the good fortune and preparation that allowed the Tampa-St. Petersburg-Clearwater area to so successfully weather hurricane Irma and to offer our best wishes to those parts of Florida that are still recovering from the storm. We have an exciting program this year that builds on the success of our previous conferences. The conferences of the past two years featured the sunshine of San Diego and the open skies of Denver. This year, now that the hurricane has passed, we double down on the sunshine and the view! St. Petersburg, known as the “sunshine city”, is the holder of a Guinness world record for an epic stretch of sunshine that lasted 768 days. So in the tradition of the best data-driven prognostication, our prediction is for delightful weather and an intellectually rewarding conference!

In addition to its stunning beaches and weather, St. Petersburg is known for its world-renowned museums, top-rated restaurants, and for beautiful Fort De Soto Park, a sprawling littoral park that includes five interconnected keys that are home to beach plants, mangroves, wetlands, palm hammocks, hardwoods and scores of native plants. As its name suggests, the park also offers the opportunity to tour the historically significant Fort De Soto. The Salvador Dali Museum is the largest collection of Dali's work outside of Spain and is home to 7 of his 18 masterwork paintings as part of a collection that includes 96 oil paintings, over 100 watercolors and drawings, 1,300 graphics, photographs, sculptures and objects d'art. The Chihuly Collection of the Morean Arts Center is a collection of world-renowned artist Dale Chihuly's unique glass artwork, displayed in a 10,000-permanent setting. The mission of the St. Petersburg Museum of History includes collections on the history and heritage of Florida with emphasis on St. Petersburg and the Pinellas Peninsula. The PHM 2017 banquet will be held at the nearby St. Petersburg Museum of the Fine Arts. The museum has a collection of more than 20,000 objects includes major works by Monet, Morisot, Barye, Rodin, O'Keeffe, Pearlstein, and Wyeth, along with ancient Greek and Roman, Egyptian, Asian, African, pre-Columbian, Native American art. Be sure to ask about the ancient artifacts buried in the museum's lawn!

The Hilton Bayfront is located in downtown St. Petersburg, the heart of the city and home to great shopping, restaurants, and attractions. Locale Market is a unique 20,000 sq-foot marketplace offering the region's freshest and finest artisanal foods. The real fun in St. Pete, starts when the sun goes down. Central Avenue is home to numerous clubs and bars including Enigma, a dance club, The Mandarin Hide and Emerald Bar. On Beach Drive, The Canopy Rooftop Lounge is a hotspot for cocktails overlooking the marina, and for live music in a small and intimate setting, Jannus Live is a top choice with a constant lineup of touring bands. The St. Petersburg Trolley's Downtown Looper route is one of the easiest ways, and certainly the most nostalgic, to get around the downtown area. Look for the bright red and yellow trolleys, board for just 50 cents and connect to all the city's major museums and attractions. If you prefer pedaling, sign up for Coast Bike Share and take advantage of their pay-as-you-go options. You may also want to try a guided tour of the city and Tampa Bay. There are Segway tours, boat tours (including dolphin watching), ghost tours, photo tours, and historic tours.

The Tampa Bay area offers wonderful outdoor activities, especially of course in the water sports. Rent a kayak or canoe at Weedon Island, swim the secluded waters of award-winning Caladesi Island, go fishing in the crystal waters of the Gulf of Mexico, or even go horseback riding on the beach. There are plenty of opportunities to keep up with your cardio exercise, too! Bike the 40-mile Pinellas Trail, take a hike at Brooker Creek Preserve or Boyd Hill Nature Park, or jog across the Clearwater Memorial Causeway with scenic views of the intercoastal waterway. Or simply get back to nature by camping on the beaches of State Parks like Anclote Key and Fort De Soto, or by bird-watching on the Great Florida Birding and Wildlife Trail.

The program for the PHM 2017 Conference is rich with technical content and the events offer many opportunities to make and renew professional connections in the field. Please enjoy this program, but also be sure to step outside into the sunshine to explore the Tampa-St. Petersburg-Clearwater area. This area is one of the jewels of Florida and there is much to experience. We hope you have a rewarding week here!

David Larsen and Peter Beling

2017 Conference Co-Chairs

The Conference

The Prognostics and Health Management Society (PHM Society) welcomes you to its annual international conference. As the Society's annual flagship event, the 2017 PHM Conference brings together the global community of PHM experts from industry, academia, and government in diverse application areas such as smart manufacturing, wind energy, oil and gas, aerospace, transportation, automotive, and industrial automation. The conference features keynote and luminary presentations, invited panel sessions, technology demonstrations, a data challenge, a doctoral symposium, tutorials free to all registrants, a dedicated poster session during planned social hours, a Job Fair, a one-day deep learning workshop and two, two-day intensive short courses (PHM Fundamentals and PHM Data Analytics) in conjunction with the conference. Several social events will provide opportunities for participants to connect with colleagues.



What Sets This Conference Apart

A major differentiator for the PHM Society is its contemporary approach toward copyright: the Society does not take ownership of your work! Instead, authors retain copyright through a Creative Commons License while allowing the PHM Society to distribute their work broadly through modern media. As a result, your original articles will reach the entire world for free and without access restrictions.

The conference includes high-quality tutorials, and original contributions submitted as full-length papers and posters. All submissions are reviewed by up to four experts in the field based on the criteria of originality, significance, quality, and clarity. The conference proceedings are published on the web for unrestricted access by the global scholarly and applications community.

Saturday, September 30, 2017			
Location Time	PHM Fundamentals Short Course	PHM Data Analytics Short Course	Location Time
	Harbor View	Williams & Demens	
8AM – 5PM	Registration		8AM – 5PM
8:00 – 12:00	PHM Fundamentals Short Course Day 1 <i>Separate Registration Required</i>	PHM Data Analytics Short Course Day 1 <i>Separate Registration Required</i>	8:00 – 12:00
12:00 – 1:00	Lunch Location: Grand Bay Ballroom South		12:00 – 1:00
1:00 – 5:15	PHM Fundamentals Short Course Day 1 <i>Separate Registration Required</i>	PHM Data Analytics Short Course Day 1 <i>Separate Registration Required</i>	1:00 – 5:15

Optional PHM Fundamentals Short Course Details and Agenda

September 30 – October 1, Room: Harbor View

Separate Registration Required

Course Leaders: Dr. George Vachtsevanos (Georgia Tech) and Dr. Karl Reichard (Pennsylvania State University)

Course Administrator: Jeff Bird (TECNos)

The PHM Society offers this updated *two-day intensive short course* titled **PHM Fundamentals and Case Studies—From Monitoring/Sensing to Fault Diagnosis/Failure Prognosis and Case Studies**, on PHM tools, methods, applications and case studies on Saturday, September 30 and Sunday, October 1 in St Petersburg, Florida USA right before the PHM17 conference. This follows from the first offering at the PHM14 conference in Fort Worth, TX with 48 attendees and ratings of 4/5. It was also run in 2015 in San Diego, 2016 in both Bilbao, Spain and Denver US. There is a Deep Learning Workshop you can attend on Monday October 2 for a minimal fee,

As in the previous offerings, the course will be taught by recognized 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 specialist experts, participants will:

- Describe a baseline for defining the extent and capabilities of PHM, specifically needs and organization
- Identify specific details of PHM Applications (metrics, sensors, cost benefits, reliability) and PHM Methods (diagnostics, prognostics, data driven methods and uncertainty)
- Identify issues and needs and a way forward including Continuing Professional Development
- Examine case studies of PHM applications across diverse domains to identify solutions and impacts
- Plan a PHM application in two mini workshop settings with expert group leaders

Note: A PHM Society Certificate will be provided for 1.4 Continuing Professional Development Units to each participant completing the course.

Saturday, September 30, 2017

8:00 – 10:30	Session 1: Welcome and Introductions Introduction to PHM Deriving Requirements for PHM PHM Performance Metrics	Harbor View
10:30 – 10:45	Break	
10:45 – 12:00	Session 2: Diagnostics Methods Diagnostics Case Studies	Harbor View
12:00 – 1:00	Lunch (provided)	Grand Bay South Ballroom
1:00 – 3:15	Session 3: Prognostics Data Analytics Methods Prognostics Case Studies	Harbor View
3:15 – 3:30	Break	
3:30 – 5:15	Session 4: Sensors and Data Processing Analysis Mini-Workshop Summary of Workshop Results	Harbor View
5:15 – 7:30	Free Time	
7:30 – ?	Non-hosted dinner with all participants	

Sunday, October 1, 2017

8:30 – 10:30	Session 5: CBM+ and IVHM Technologies PHM Management Cost Benefit Analysis Plenary—Issues and Needs	Harbor View
10:30 – 10:45	Break	
10:45 – 12:30	Session 6: Reliability and Life Cycle Management Fielded Systems Case Studies – 1	Harbor View
12:30 – 1:30	Lunch (provided)	Grand Bay South Ballroom
1:30 – 3:20	Session 7: Fielded Systems Case Studies – 2 Case Study Mini-Workshop Introduction Case Study Mini-Workshop	Harbor View
3:20 – 3:40	Break	
3:40 – 4:15	Session 8: Way Forward Wrap up with Evaluation Forms	Harbor View

Sunday, October 1, 2017				
Location	PHM Fundamentals Short Course	PHM Data Analytics Short Course	IST Round Table	Location
Time	Harbor View	Williams & Demens	Bayboro	Time
8AM – 5PM	Registration			8AM – 5PM
8:30 – 12:00	PHM Fundamentals Short Course Day 2 <i>Separate Registration Required</i>	PHM Data Analytics Short Course Day 2 <i>Separate Registration Required</i>	Next-Generation PHM and Intelligent Systems Technologies Round Table <i>Limited Invitation Only</i>	8:30 – 12:00
12:00 – 1:30	Lunch			12:00 – 1:30
1:30 – 4:15	PHM Fundamentals Short Course Day 2 <i>Separate Registration Required</i>	PHM Data Analytics Short Course Day 2 <i>Separate Registration Required</i>	Next-Generation PHM and Intelligent Systems Technologies Round Table <i>Limited Invitation Only</i>	1:30 – 5:00
4:15 – 5:15	Free Time			5:00 – 5:15

Optional PHM Data Analytics Short Course Details and Agenda

September 30 – October 1, Room: Harbor View

Separate Registration Required

Course Leader: **Dr. Neil Eklund** (Anatom)

Course Administrator: **Jeff Bird** (TECnos)

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.

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, and have some free software pre-installed.

A PHM Society Certificate will be provided for nominally 1.4 Continuing Professional Development Units to each participant completing the lecture and lab portion of the course, or 1.0 Continuing Professional Development Units to each participant completing only the lecture.

The course is designed for two primary types of students:

Managers who oversee asset health management projects, and want to know more about the technical details behind the process.

Practitioners who want to know the theory and get hands-on experience for data driven PHM, including:

- Students
- New engineers and scientists
- Experienced engineers and scientists looking to update their skills and understanding data driven methods
- Project managers who incorporate data driven PHM in their projects
- Individuals with a general understanding of analytics who want to see how it is applied to PHM

Note that this course is an advanced course with only a cursory background in PHM presented - students are expected to know the basics of PHM already. New practitioners are encouraged to take the PHM fundamentals course or contact the course leader to examine their background and skills.

Saturday, September 30, 2017

8:00 – 10:30	Session 1:	Williams & Demens
	Welcome and Introductions	
	Overview of Data-driven PHM	
	Review of Basic Statistics	
	Exploratory Data Analysis	
10:30 – 10:45	Break	
10:45 – 12:00	Session 2:	Williams & Demens
	Machine Learning—Introduction and Concepts	
	Data Transformation and Feature Extraction	
	Classification	
12:00 – 1:00	Lunch (provided)	Grand Bay South Ballroom
1:00 – 3:15	Session 3:	Williams & Demens
	Regression	
3:15 – 3:30	Break	
3:30 – 5:15	Session 4:	Williams & Demens
	Hands-on Lab	
5:15 – 7:30	Free Time	
7:30 – ?	Non-hosted dinner with all participants	

Sunday, October 1, 2017

8:30 – 10:30	Session 5:	Williams & Demens
	Feature Selection	
	Characterizing Performance	
10:30 – 10:45	Break	
10:45 – 12:30	Session 6:	Williams & Demens
	Model Selection	
	Anomaly Detection	
12:30 – 1:30	Lunch (provided)	Grand Bay South Ballroom
1:30 – 3:20	Session 7:	Williams & Demens
	Applications	
	Practical Matters	
3:20 – 3:40	Break	
3:40 – 5:15	Session 8:	Williams & Demens
	Hands-on Lab	
	Wrap up with Evaluation Forms	

Monday, October 2, 2017				
Time	Location	Deep Learning Workshop	Doctoral Symposium	Location
		St. Petersburg 1	Bayboro	Time
7AM – 5PM		Registration		
8:00 – 9:00		Free Time	Doctoral Symposium Breakfast	8:00 – 9:15
9:00 – 12:00		Deep Learning Workshop <i>Separate Registration Required</i>	Doctoral Symposium	9:15 – 11:50
12:00 – 1:00		Lunch	Doctoral Symposium Lunch	12:00 – 1:00
1:00 – 4:30		Deep Learning Workshop <i>Separate Registration Required</i>	Doctoral Symposium	1:00 – 5:15
4:30 – 5:30		Free Time	Free Time	5:15 – 5:30
5:30 – 7:30		Opening Welcome Reception with Cocktails Location: Poolside		

Optional Deep Learning Workshop Details and Agenda

Monday, October 2, Room: St. Petersburg 1

Separate Registration Required

Workshop Leaders: *Dr. Neil Eklund (Analatom)*, *Dr. Weizhong Yan (GE Research)*, and *Dr. Jose Celaya (Schlumberger)*

The Prognostics and Health Management Society Annual Conference is the premier meeting of experts on Prognostics, Diagnostics, and System Health Management. Building on the 2015 Conference *Deep Learning for Feature Engineering* tutorial, and the large number of papers on deep learning presented at the 2016 Conference, we are holding a dedicated one-day *Deep Learning for Industrial Analytics Workshop* at the 2017 Conference. This first-of-a-kind workshop brings together experts from the PHM community and the deep learning community and provide an ideal forum for technical interchange and exploring the transfer of deep learning techniques from other applications to PHM.

The past ten years have witnessed a revolution in machine learning, statistics, and hardware. Neural networks have risen from relative obscurity as a collection of innovative new techniques known as Deep Learning, and are achieving human-level performance in image recognition and game playing. Around the same time, a niche discipline of Industrial Analytics has emerged, characterized by predictive analytics and optimization for fleets of similar assets – e.g., aircraft engines, subsea oil pumps, computed tomography scanners. Papers describing both novel applications of the combination of these techniques and related theory are encouraged.

The workshop will consist of invited talks, panels with deep learning researchers, and technical papers.

Topics of interest include:

- Detection, Diagnostics & Prognostics Methods
- Deep Learning for time series data
- Adaptive Control & Fault Accommodation
- Autonomous Systems/Robotic Technologies
- Decision Support Systems

With applications in:

Automotive	Medical Equipment	Smart Manufacturing
Aviation	Mining	Wind Energy
Locomotive	Oil & Gas	etc.
Marine	Smart Grid	

Organizing Committee:

Neil Eklund (Analatom), *Workshop Chair*
José Celaya (Schlumberger)
Weizhong Yan (GE Research)

Monday, October 2, 2017

9:00 – 10:30	Session 1: Welcome and Introduction Keynote I	St. Petersburg 1
10:30 – 11:00	Break	
11:00 – 12:00	Session 2: Keynote II	St. Petersburg 1
12:00 – 1:00	Lunch (provided)	
1:00 – 2:30	Session 3: Panel Session I: Applications	St. Petersburg 1
2:30 – 3:00	Break	
3:00 – 4:30	Session 4: Panel Session II: Future of Deep Learning and PHM	St. Petersburg 1

Want to be a part of next year's PHME2018 Conference (in the Netherlands) or PHM2018 Conference (in Philadelphia)? See page 18 for details!

Doctoral Symposium Agenda

(See Page 12 for Details)

Monday, October 2, 2017

8:00 – 9:15	Breakfast (provided)	Bayboro
9:15 – 9:30	Doctoral Symposium Welcome	
9:30 – 9:50	Presentation #1: A New Approach to High Impedance Fault Detection and Location for Distribution Systems – Roghieh Abdollahi (Clemson University)	Bayboro
9:50 – 10:20	Panelist Feedback (20m) / Audience Q&A (10m)	
10:20 – 10:40	Presentation #2: Development of Deep Learning Based Prognostics for Rotating Components – Jason Deutsch (University of Illinois, Chicago)	Bayboro
10:40 – 11:10	Panelist Feedback (20m) / Audience Q&A (10m)	
11:10 – 11:30	Presentation #3: Fleet Prognostics and Health Management – A General Process Model for Data-Driven Fleet Analytics – Carolin Wagner (University of Münster)	Bayboro
11:30 – 12:00	Panelist Feedback (20m) / Audience Q&A (10m)	
12:00 – 1:00	Lunch (provided)	Bayboro
1:00 – 1:20	Presentation #4: Probabilistic Life Prediction and Prognostics-Based Maintenance Optimization for Gas Pipelines – Yuhao Wang (Arizona State University)	Bayboro
1:20 – 1:50	Panelist Feedback (20m) / Audience Q&A (10m)	
1:50 – 2:10	Presentation #5: Vibration-Based Fault Detection and Quantification for Primary Flight Control Electro-Mechanical Actuators – Mohamed Ismail (Institute of Flight Systems, German Aerospace Center (DLR))	Bayboro
2:10 – 2:40	Panelist Feedback (20m) / Audience Q&A (10m)	
2:40 – 3:00	Break	
3:00 – 3:20	Presentation #6: Enhanced System Health Assessment Using Adaptive Self-Learning Techniques – Yuan Di (University of Cincinnati)	Bayboro
3:20 – 3:50	Panelist Feedback (20m) / Audience Q&A (10m)	
3:50 – 4:10	Presentation #7: Development and Application of Advanced Data-Driven Methods for Prognostics and Health Management of Industrial Components under Scarce Degradation Information – Francesco Cannarile (Politecnico di Milano)	Bayboro
4:10 – 4:40	Panelist Feedback (20m) / Audience Q&A (10m)	
4:40 – 5:00	Panelists Final Thoughts	
5:00 – 5:15	Feedback from Students & Audience	

Round Table Panel on Next Generation PHM and Intelligent System Technologies (Co-Located with PHM2017)

Sunday, October 1, 8:30 – 5:00, Room: Bayboro

Limited Attendance for Invited Speakers and Participant. Other interested attendees please contact event organizing committee.

Organizing Committee:

Jay Lee (University of Cincinnati), Round Table Chair

Andrew Hess (The Hess PHM Group)

Jerry Shan (Huawei)

Yuhong Zhang (Huawei)

Scope: Discuss and identify the Next Generation PHM and Intelligent System Technologies (including machine learning, industrial big Data, digital twin, and etc.) as well as their Impacts to Future Smart Product, Manufacturing, and Service Systems.

Roundtable Format: The Panel consists of 10-12 Subject Matter Experts from the industry and the academia. Each panelist will give a 25-minute presentation on the Next Generation Intelligent System Technologies: machine learning, industrial big Data, and etc. based on his/her work and research experience. The participants and panelists will have open discussions throughout the day.

Speaker List:

Jay Lee (University of Cincinnati)

Andrew Hess (The Hess PHM Group)

Dragan Djurdjanovic (University of Texas at Austin)

Neil Eklund (Analatom)

Kai Goebel (NASA)

Karl Reichard (Pennsylvania State University)

Abhinav Saxena (GE Global Research)

Terry Hickey (IBM Global Services)

Weizhong Yan (GE Global Research)

Hendrik F. Hamann (IBM Research)

Jerry Shan (Huawei)

David Siegel (Predictrics)

<http://imscenter.net/phm-2017-round-table/round-table-panel-on-next-generation-phm-and-intelligent-system-technologies>

(or <http://bit.ly/2flcHr5>)



Hurricane Relief Efforts

The PHM Society stands with the victims of the recent spate of hurricanes and encourages all of its members to consider donating to the relief efforts. Hurricane Irma narrowly missed a direct hit on the PHM Conference venue itself in St. Petersburg but did inflict great damage. The Charity Navigator website provides one way to ensure your dollars are having the greatest possible impact for those in need. Please see <https://www.charitynavigator.org/index.cfm?bay=content.view&cpid=5243> (or <http://bit.ly/2wX7Thg>) and THANK YOU!



Tuesday, October 3, 2017

Time	Location	Technical Paper Sessions	Technical Paper & Tutorial Sessions	Career Fair
		St. Petersburg 2	St. Petersburg 3	Sponsor Area & Skyway & Pier
7AM – 5PM		Registration		
7:30 – 8:00		Continental Breakfast		Location: Grand Bay Ballroom & Foyer
8:00 – 8:45		Opening Remarks Luminary Presentation: Elaine Spiller (Marquette University) “Uncertainty in hazard forecasting: Or where will you go when the volcano blows?”		
8:45 – 10:15		Paper Session 1A: Batteries I	Paper Session 1B: Industrial & Manufacturing Applications	Reserved for PHM Conference
10:15 – 10:30		Break		Location: St. Petersburg Foyer
10:30 – 12:00		Paper Session 2A: Batteries II	Paper Session 2B: Deep Learning	Career Fair (see page 12 for details)
12:00 – 1:15		Conference Lunch Keynote Speaker: Ravi Rajamani (drR² consulting) “Electric Aircraft: The Future of Flight, or a Fleeting Fancy?”		
1:15 – 3:00		Paper Session 3A: Wind Turbines	Tutorial Session 1: Model-Based Prognostics—An Introduction <i>Indranil Roychoudhury (SGT, NASA Ames Research Center)</i>	Follow-up Discussions and 1:1 Interviews
3:00 – 3:30		Break		Location: St. Petersburg Foyer
3:30 – 5:00		Paper Session 4A: Diagnostics	Tutorial Session 2: Design, Development, and Testing of PHM Software <i>Chris Teubert (NASA Ames Research Center)</i>	Follow-up Discussions and 1:1 Interviews
5:00 – 6:00		Free Time		
6:00 – 7:30		Cocktail Reception with Posters		Location: Grand Bay Ballroom

Paper Session 1A: Batteries I

Tuesday, 8:45 – 10:15, Room: St. Petersburg 2

Session Chair: Kai Goebel (NASA Ames Research Center)

Energy Management of Electric Bicycles Given a Traveling Elevation Profile – Sebastián Seria¹, Vanessa Quintero², Pablo A. Espinoza³, Aramis Pérez⁴, Francisco Jaramillo⁵, Matías Benavides⁶, Marcos Orchard⁷ (^{1,2,3,4,5,6,7}University of Chile, Chile)

Use of Teaching-Learning Based Optimization for Filter Parameter Tuning in the Prognostics of a Quadrotor Battery – Leonardo Ramos Rodrigues¹, João Paulo Pordeus Gomes², Vandilberto Pereira Pinto³, Roberto Kawakami Harrop Galvão⁴ (¹Institute of Aeronautics and Space, Brazil; ^{2,3}Federal University of Ceará, Brazil; ⁴Instituto Tecnológico de Aeronáutica, Brazil)

GPU Accelerated Prognostics – George E. Gorospe¹, Matthew J. Daigle², Shankar Sankararaman³, Chetan S. Kulkarni⁴, Eley Ng⁵ (^{1,3,4}SGT Inc., NASA Ames Research Center; ²NIO USA, Inc.; ⁵Universities Space Research Association)

Lithium-ion Battery Remaining Useful Life Prediction with Long Short-term Memory Recurrent Neural Network – Yuefeng Liu¹, Guangquan Zhao², Xiyuan Peng³, Cong Hu⁴ (^{1,2,3}Harbin Institute of Technology, China; ¹Inner Mongolia University of Science & Technology, Inner Mongolia; ⁴Guilin University of Electronic Technology, China)

Paper Session 1B: Industrial & Manufacturing Applications

Tuesday, 8:45 – 10:15, Room: St. Petersburg 3

Session Chair: Francesco Cannarile (Politecnico di Milano)

Fleet Knowledge for Prognostics and Health Management – Identifying Fleet Dimensions and Characteristics for the Categorization of Fleets – Carolin Wagner¹, Bernd Hellgrath² (^{1,2}Westfälische Wilhelms-Universität Münster, Germany)

Dynamic Modeling of Maintenance Prices in the Aerospace

Industry – George S. Ekladios¹, Xiaojun Zhao², Hala Mostafa³, Ramona Georgescu⁴ (^{1,2,3,4}United Technologies Research Center)

Case Studies in using Consumer Analytics with PHM Strategy – Sameer Vittal¹, Mark Sporer² (¹GE Power; ²GE Renewables)

A New Application for Failure Prognostics – Reduction of Automotive Electronics Reliability Test Duration – Andre Kleynner¹, Arvind Vasan², Michael Pecht³ (¹Delphi Electronics & Safety; ²Empower Micro Systems Inc.; ³CALCE Research Center, University of Maryland)

Paper Session 2A: Batteries II

Tuesday, 10:30 – 12:00, Room: St. Petersburg 2

Session Chair: Chetan Kulkarni (SGT Inc., NASA Ames Research Center)

Flight Tests of a Remaining Flying Time Prediction System for Small Electric Aircraft in the Presence of Faults – Edward F. Hogge¹, Chetan S. Kulkarni², Sixto L. Vazquez³, Kyle M. Smalling⁴, Thomas H. Strom⁵, Boyd L. Hill⁶, Cuong C. Quach⁷ (^{1,4,5}Northrop Grumman Technology Services; ²SGT, Inc., NASA Ames Research Center; ^{1,3,4,5,6,7}NASA Langley Research Center; ⁶Analytical Mechanics Associates, Inc.)

A Simulation Engine for Predicting State-of-Charge and State-of-Health in Lithium-Ion Battery Packs of Electric Vehicles – Pablo A. Espinoza¹, Aramis Pérez², Marcos E. Orchard³, Hugo F. Navarrete⁴, Daniel A. Pola⁵ (^{1,2,3,4,5}University of Chile, Chile)

An Improved Model for Remaining Useful Life Prediction on Capacity Degradation and Regeneration of Lithium-ion Battery – Li-Ming Deng¹, Yu-Cheng Hsu², Han-Xiong Li³ (^{1,2,3}City University of Hong Kong, China)

Paper Session 2B: Deep Learning

Tuesday, 10:30 – 12:00, Room: St. Petersburg 3

Session Chair: Neil Eklund (Anatom)

Tuesday, October 3, 2017		
Panel Sessions	Technology Demos	Location
St. Petersburg 1	Williams & Demens	Time
Registration		7AM – 5PM
Continental Breakfast		Location: Grand Bay Ballroom & Foyer
Opening Remarks		Location: Grand Bay Ballroom
Luminary Presentation: Elaine Spiller (Marquette University) “Uncertainty in hazard forecasting: Or where will you go when the volcano blows?”		8:00 – 8:45
Panel Session 1: Smart Manufacturing PHM <i>David Siegel (Predictronics)</i>	Reserved for PHM Conference	8:45 – 10:15
Break		Location: St. Petersburg Foyer
Panel Session 2: Human Machine Interfaces for Smart PHM <i>Jeremy Marvel (NIST)</i>	Reserved for PHM Conference	10:15 – 10:30
Conference Lunch Keynote Speaker: Ravi Rajamani (drR² consulting) “Electric Aircraft: The Future of Flight, or a Fleeting Fancy?”		Location: Grand Bay Ballroom
Panel Session 3: Automotive PHM and Emerging Standards <i>Steven W. Holland (General Motors)</i>	Technology Demonstration: Automotive Application of PHM Concepts via Cadillac SRX Rig [General Motors]	12:00 – 1:15
Break		Location: St. Petersburg Foyer
Panel Session 4: PHM for the Electric Power Grid <i>Avi Gopstein (NIST)</i>	Technology Demonstration: Machine Health Monitoring via Internet of Things Platform [Mathworks]	3:00 – 3:30
Free Time		3:30 – 5:00
Cocktail Reception with Posters		Location: Grand Bay Ballroom
		5:00 – 6:00
		6:00 – 7:30

Deep Feature Learning Network for Fault Detection and Isolation
 – Gabriel Michau¹, Thomas Palmé², Olga Fink³ (^{1,3}Zurich University of Applied Sciences, Switzerland; ²General Electric (GE), Switzerland)

Unsupervised Deep Learning for Gear Health Monitoring – Tyler Cody¹, Stephen Adams², Peter A. Beling³ (^{1,2,3}University of Virginia)

Bearing Health Condition Prediction Using Deep Belief Network
 – Guangquan Zhao¹, Xiaoyong Liu², Bin Zhang³, Guohui Zhang⁴, Guangxing Niu⁵, Cong Hu⁶ (^{1,2,4}Harbin Institute of Technology, China; ^{3,5}University of South Carolina; ⁶Guilin University of Electronic Technology, China)

Paper Session 3A: Wind Turbines

Tuesday, 1:15 – 3:00, Room: St. Petersburg 2

Session Chair: Jason Deutsch (University of Illinois, Chicago)

Adaptive Training of Vibration-based Anomaly Detector for Wind Turbine Condition Monitoring – Takanori Hasegawa¹, Jun Ogata², Masahiro Murakawa³, Tetsunori Kobayashi⁴, Tetsuji Ogawa⁵ (^{1,4,5}Waseda University, Japan; ^{1,2,3,5}National Institute of Advanced Industrial Science and Technology, Japan)

Wind Turbine Intelligent Gear Fault Identification – Sofia Koukoura¹, James Carroll², Alasdair McDonald³ (^{1,2,3}University of Strathclyde, UK)

Small-Scale Wind Turbine Recurrence and Cost Modeling as a Function of Operational Covariates from Supervisory Control and Data Acquisition Systems – Michael S. Czahor¹, William Q. Meeker² (^{1,2}Iowa State University)

Paper Session 4A: Diagnostics

Tuesday, 3:30 – 5:00, Room: St. Petersburg 2

Session Chair: Michael Sharp (NIST)

Diagnostics of machine tool linear axes via separation of geometric error sources – Gregory W. Vogl¹, Michael E.

Sharp² (^{1,2}National Institute of Standards and Technology)
Towards Diagnosing Cascading Outages in Cyber Physical Energy Systems using Temporal Causal Models – Ajay Chhokra¹, Nagabhushan Mahadevan², Abhishek Dubey³, Daniel Balasubramanian⁴, Gabor Karsai⁵ (^{1,2,3,4,5}Vanderbilt University)

Internet of Turbines: An Outlook on Smart Diagnostics – Gulnar Mehdi¹, Mikhail Roshchin², Thomas Runkler³ (^{1,2,3}Siemens AG, Germany; ^{1,3}Technical University Munich, Germany)

Diagnosis and Prognosis of Fuel Injectors based on Control Adaptation – Azeem Sarwar¹, Chaitanya Sankavaram², Xiangxing Lu³ (^{1,2,3}General Motors Company)

Technology Demonstrations

Tuesday, October 3, 2017

Williams & Demens

General Motors

1:15 – 3:00

Automotive Application of PHM Concepts via Cadillac SRX Rig

MathWorks

3:30 – 5:00

Machine Health Monitoring via Internet of Things Platform

Wednesday, October 4, 2017

Williams & Demens

General Motors

1:15 – 3:00

Automotive Application of PHM Concepts via Cadillac SRX Rig

Life Prediction Technologies

3:30 – 5:00

Model-based Predictive Maintenance Solutions for Specific Turbine Engines

Wednesday, October 4, 2017					
Time	Location	Technical Paper Sessions	Technical Paper Sessions	Career Fair	Smart Manufacturing Workshop
		St. Petersburg 2	St. Petersburg 3	Skyway & Pier	Bayboro
7AM – 5PM		Registration			
7:30 – 8:00		Continental Breakfast			
		Location: Grand Bay Ballroom & Foyer			
8:00 – 8:45		Opening Remarks			
		Location: Grand Bay Ballroom			
		Keynote Speaker: Steve Holland (<i>General Motors</i>)			
		“Issues and Opportunities in Automotive PHM”			
8:45 – 10:15		Paper Session 5A: Aviation I	Paper Session 5B: Data Driven Methods I	Follow-up Discussions and 1:1 Interviews (see page 12 for details)	Smart Manufacturing Standards Workshop Brian Weiss (<i>NIST</i>) and Donnie Alonzo (<i>ASME</i>)
10:15 – 10:30		Break			
		Location: St. Petersburg Foyer			
10:30 – 12:00		Paper Session 6A: Aviation II	Paper Session 6B: Data Driven Methods II	Follow-up Discussions and 1:1 Interviews	Smart Manufacturing Standards Workshop (cont'd) Brian Weiss (<i>NIST</i>) and Donnie Alonzo (<i>ASME</i>)
12:00 – 1:15		Lunch on your own			
1:15 – 3:00		Paper Session 7A: Systems I	Paper Session 7B: Structural Health Management	Reserved for PHM Conference	Reserved for PHM Conference
3:00 – 3:30		Break			
		Location: St. Petersburg Foyer			
3:30 – 5:00		Paper Session 8A: Systems II	Paper Session 8B: Anomaly Detection	Reserved for PHM Conference	Reserved for PHM Conference
5:00 – 6:00		Free Time			
6:00 – 10:00		** Greece-themed ** See “Social Program” on p. 17	PHM Conference Banquet Museum of Fine Arts		For guest tickets, please see Registration Desk

Paper Session 5A: Aviation I

Wednesday, 8:45 – 10:15, Room: St. Petersburg 2

Session Chair: Karl Reichard (*Pennsylvania State University*)

Fast Optimization for aircraft Descent and Approach Trajectory – Dmitry G. Luchinskiy¹, Stefan Schuet², J. Brenton³, Dogan Timucin⁴, David Smith⁵, John Kaneshige⁶ (¹*SGT, Inc.*; ^{2,3,4,5,6}*NASA Ames Research Center*)

Health-Informed Uncertainty Quantifications via Bayesian Filters with Markov Chain Monte Carlo Simulations for Fatigue Critical Rotorcraft Components – Michael Shiao¹, Anindya Ghoshal² (^{1,2}*Army Research Laboratory*)

Reducing the Impact of Test Bench Component on the Thrust Margin Measurement – Mohammed Meqqadmi¹, Pierre-Etienne Mosser², Thierry Brichler³, Jérôme Lacaille⁴ (^{1,2,3,4}*Safran Aircraft Engines, France*)

Paper Session 5B: Data Driven Methods I

Wednesday, 8:45 – 10:15, Room: St. Petersburg 3

Session Chair: Jamie Coble (*University of Tennessee, Knoxville*)

A Method for Measuring the Robustness of Diagnostic Models for Predicting the Break Size during LOCA – Xiang Tian¹, Victor Becerra², Nils Bausch³, Gopika Vinod⁴, T.V. Santhosh⁵ (^{1,2,3}*University of Portsmouth, UK*; ^{4,5}*Bhabha Atomic Research Centre, India*)

Condition Monitoring of a Reciprocating Compressor Using Wavelet Transformation and Support Vector Machines – Shawn Falzone¹, Jason R. Kolodziej² (^{1,2}*Rochester Institute of Technology*)

Data Driven Modeling and Estimation of Accumulated Damage in Mining Vehicles using On-board Sensors – Erik Jakobsson¹, Erik Frisk², Robert Pettersson³, Mattias Kryssander⁴ (^{1,3}*Atlas Copco Rock Drills AB, Sweden*; ^{1,2,4}*Linköping University, Sweden*)

Fault Detection By Segment Evaluation Based On Inferential Statistics For Asset Monitoring – Vepa Atamuradov¹, Kamal Medjaher², Benjamin Lamoureux³, Pierre Dersin⁴, Noureddine

Zerhouni⁵ (^{1,2}*INP-ENIT, France*; ^{3,4}*ALSTOM Transport, France*; ⁵*FEMTO-ST Institute, France*)

Paper Session 6A: Aviation II

Wednesday, 10:30 – 12:00, Room: St. Petersburg 2

Session Chair: Yuan Di (*University of Cincinnati*)

A Case for the Use of Data-driven Methods in Gas Turbine Prognostics – Marcia Baptista¹, Cairo L. Nascimento², Helmut Prendinger³, Elsa Henriques⁴ (^{1,4}*Universidade de Lisboa, Portugal*; ²*Instituto Tecnológico de Aeronautica, Brazil*; ³*National Institute of Informatics, Japan*)

Effect of Ambient Temperature on Performance of Gas Turbine Engine – Yuan Liu¹, Avisekh Banerjee², Amar Kumar³, Alka Srivastava⁴, Nita Goel⁵ (^{1,2}*Life Prediction Technology Inc., Canada*; ^{3,4,5}*Tecsis Corporation, Canada*)

Prospective Architectures for Onboard vs Cloud-based Decision Making for Unmanned Aerial Systems – Shankar Sankararaman¹, Christopher Teubert² (¹*SGT, Inc.*; ^{1,2}*NASA Ames Research Center*)

Paper Session 6B: Data Driven Methods II

Wednesday, 10:30 – 12:00, Room: St. Petersburg 3

Session Chair: Mohamed Ismail (*Institute of Flight Systems, German Aerospace Center (DLR)*)

A Compressed Sensing Feature Extraction Approach for Diagnostics and Prognostics in Electromagnetic Solenoids – Christian Knoebel¹, Hanna Wenzl², Johannes Reuter³, Clemens Guehmann⁴ (^{1,2,3}*University of Applied Sciences Konstanz, Germany*; ⁴*Technische Universität Berlin, Germany*)

Fault Detection and Prognosis of Time Series Data with Random Projection Filter Bank – Sepideh Pourazarm¹, Amir-massoud Farahmand², Daniel Nikovski³ (¹*Mitsubishi Electric Research Laboratories*)

A Comparison of Acoustic Emission and Vibration Measurements for Condition Monitoring of an Offshore Drilling Machine –

Wednesday, October 4, 2017			
	Panel Sessions	Technology Demos	Location
	St. Petersburg 1	Williams & Demens	Time
	Registration		7AM – 5PM
	Continental Breakfast	Location: Grand Bay Ballroom & Foyer	7:30 – 8:00
	Opening Remarks Keynote Speaker: Steve Holland (General Motors) “Issues and Opportunities in Automotive PHM”		8:00 – 8:45
	Invited Session: Data Challenge Winners <i>Justinian Rosca (Siemens)</i>	<i>Reserved for PHM Conference</i>	8:45 – 10:15
	Break	Location: St. Petersburg Foyer	10:15 – 10:30
	Panel Session 5: PHM Applications Deployment <i>Tomasz Pancewicz (GE Aviation)</i>	<i>Reserved for PHM Conference</i>	10:30 – 12:00
	Lunch on your own		12:00 – 1:15
	Panel Session 6: PHM in Railway Maintenance <i>Parham Shahidi (PARC)</i>	Technology Demonstration: Automotive Application of PHM Concepts via Cadillac SRX Rig [General Motors]	1:15 – 3:00
	Break	Location: St. Petersburg Foyer	3:00 – 3:30
	Panel Session 7: PHM Education and Standards <i>Jeff Bird (TECNOS) and Ravi Rajamani (drR² consulting)</i>	Technology Demonstration: Model-based Predictive Maintenance Solutions for Specific Turbine Engines [Life Prediction Technologies]	3:30 – 5:00
	Free Time		5:00 – 6:00
	** Greece-themed ** See “Social Program” on p. 17	PHM Conference Banquet Museum of Fine Arts	For guest tickets, please see Registration Desk 6:00 – 10:00

Martin Hemmer¹, Tor I. Waag² (¹University of Agder, Norway;
²Teknova AS, Norway)

Paper Session 7A: Systems I

Wednesday, 1:15 – 3:00, Room: St. Petersburg 2

Session Chair: George Gorospe (SGT Inc., NASA Ames Research Center)

Inferential Framework for Autonomous Cryogenic Loading Operations – Dmitry G. Luchinskiy¹, Michael Khasin², Dogan Timucin³, Jarred Sass⁴, Jose Perotti⁵, Barbara Brown⁶ (^{1,2}SGT, Inc.; ³NASA Ames Research Center; ^{4,5,6}Kennedy Space Center)

Integration of Prognostics at a System Level: a Petri Net Approach – Manuel Chiachio¹, Juan Chiachio², Shankar Sankararaman³, John Andrews⁴ (^{1,2,4}University of Nottingham, UK; ³NASA Ames Research Center)

Why Autonomous Assets are Good for Reliability – the Impact of ‘Operator-related Component’ Failures on Heavy Mobile Equipment Reliability – Melinda R. Hodkiewicz¹, Zac Batsioudis², Tyler Radomiljac³, Mark T.W. Ho⁴ (^{1,2,3,4}University of Western Australia, Australia)

Paper Session 7B: Structural Health Management

Wednesday, 1:15 – 3:00, Room: St. Petersburg 3

Session Chair: Juan Chiachio (University of Nottingham)

Low Computation Acoustic Emissions Structural Health Monitoring Through Analog Signal Pre-Processing – Rune Schlanbusch¹, Eric Bechhoefer², Thomas J. J. Meyer³ (^{1,3}Teknova, Norway; ²GPMS Inc.)

Low-complexity Behavioral Model for Predictive Maintenance of Railway Turnouts – Pegah Barkhordari¹, Roberto Galeazzi², Alejandro de Miguel Tejada³, Ilmar F. Santos⁴ (^{1,2,3,4}Technical University of Denmark, Denmark)

Impact Damage Prediction for Wave Energy Converters – Ryan Meekins¹, Stephen Adams², Kevin Farinholt³, Nathan Hipwell⁴, Michael Desrosiers⁵, Peter Beling⁶ (^{1,2,6}University of

Virginia; ^{3,4,5}Luna Innovations, Inc.)

Preliminary Results on Condition Monitoring of Fiber Ropes using Automatic Width and Discrete Length Measurements – Shaun Falconer¹, Andreas Gromsrud², Espen Oland³, Geir Grasmø⁴ (^{1,2,4}University of Agder, Norway; ³Teknova AS, Norway)

Paper Session 8A: Systems II

Wednesday, 3:30 – 5:00, Room: St. Petersburg 2

Session Chair: Roghieh Abdollahi (Clemson University)

Gear Fault Diagnostics Using Extended Phase Space Topology – T. Haj Mohamad¹, C. Nataraj² (^{1,2}Villanova Center for Analytics of Dynamical Systems)

Actuator Fault-Detection for Autonomous Underwater Vehicles Using Unsupervised Learning – Matt Kemp¹, Ben Raanan² (^{1,2}Monterey Bay Aquarium Research Institute)

Unobtrusive Software and System Health Management with R2U2 on a parallel MIMD Coprocessor – Johann Schumann¹, Patrick Moosbrugger² (¹SGT, Inc., NASA Ames Research Center; ²Vienna University of Technology, Austria)

Paper Session 8B: Anomaly Detection

Wednesday, 3:30 – 5:00, Room: St. Petersburg 3

Session Chair: Dmitry Luchinsky (SGT Inc., NASA Ames Research Center)

Anomaly Detection Using Dynamical Linear Models and Sequential Testing on a Marine Engine System – Erik Vanem¹, Geir Olve Storvik² (¹DNV GL, Norway; ^{1,2}University of Oslo, Norway)

Leak Detection in Compressed Air Systems using Unsupervised Anomaly Detection Techniques – Antoine Desmet¹, Matthew Delore² (¹Komatsu Mining Corporation, Australia; ²University of Newcastle, Australia)

Early Warnings for failing Train Axle Bearings based on Temperature – M.F.E. Peters¹ (¹Netherlands Railways (NS), Nederland)

Thursday, October 5, 2017			
Time	Location	Technical Paper Sessions	Technical Paper & Tutorial Sessions
		St. Petersburg 2	St. Petersburg 3
7AM – 12PM		Registration	
7:30 – 8:00		Continental Breakfast	Location: Grand Bay Ballroom & Foyer
8:00 – 8:45		Opening Remarks	Location: Grand Bay Ballroom
		Luminary Presentation: Gilbert Haddad (<i>Sparkcognition</i>) “Digital Transformation Across Industries: Is PHM only for Industrial Assets?”	
8:45 – 10:15		Paper Session 9A: Standards & Methodologies	Tutorial Session 3: Electronics PHM <i>Patrick Kalgren (Singularity – Intelligence Amplified)</i>
10:15 – 10:30		Break	Location: St. Petersburg Foyer
10:30 – 12:00		Paper Session 10A: Bearings PHM	Tutorial Session 4: Deep Learning for PHM <i>Emilien Dupont (Schlumberger)</i>
12:00 – 1:15		Lunch on your own PHM18 & PHME18 Planning Meeting (12:30 – 1:15)	Location: Harbor View
1:15 – 3:00		Paper Session 11A: Railway PHM	Paper Session 11B: Prognostics I
3:00 – 3:30		Break	Location: St. Petersburg Foyer
3:30 – 5:00		Paper Session 12A: Electronics PHM	Paper Session 12B: Prognostics II
5:00 – 5:30		Closing Remarks	Location: St. Petersburg 1

Paper Session 9A: Standards & Methodologies

Thursday, 8:45 – 10:15, Room: St. Petersburg 2

Session Chair: Carolin Wagner (University of Münster)

Identification of Industrial Robot Arm Work Cell Use Cases and a Test Bed to Promote Monitoring, Diagnostic, and Prognostic Technologies – Brian A. Weiss¹, Alexander Klinger² (¹National Institute of Standards and Technology)

Trends in Research Techniques of Prognostics for Gas Turbines and Diesel Engines – Joseph T. Bernardo¹, Karl M. Reichard² (^{1,2}The Pennsylvania State University Applied Research Laboratory)

The Role of Transactional Data in Prognostics and Health Management Work Processes – Sarah Lukens¹, Manjish Naik², Xiaohui Hu³, Donald S. Doan⁴, Shaddy Abado⁵ (^{1,2,3,4,5}GE Digital)

A Generic Software Architecture for Prognostics – Christopher Teubert¹, Matthew Daigle², Shankar Sankararaman³, Kai Goebel⁴, Jason Watkins⁵ (^{1,2,3,4}NASA Ames Research Center; ³SGT, Inc.; ⁵University of California,)

Paper Session 10A: Bearings PHM

Thursday, 10:30 – 12:00, Room: St. Petersburg 2

Session Chair: Manuel Chiachio (University of Nottingham)

Challenges And Opportunities in Applying Vibration Based Condition Monitoring in Railways – Diego A. Tobon-Mejia¹, Pierre Dersin², Gerard Tripot³ (^{1,2,3}ALSTOM, France)

Steps Toward Prognostics of Faults in Bearings – Eyal Madar¹, Gideon Kogan², Dmitri Gazizulin³, Renata Klein⁴, Jacob Bortman⁵ (^{1,2,3,5}Ben-Gurion University of the Negev, Israel; ⁴R.K. Diagnostics, Israel)

Feature Extraction for Bearing Prognostics using Correlation Coefficient Weight – Seokgoo Kim¹, Chaeyoung Lim², Joo-Ho Choi³ (^{1,2,3}Korea Aerospace University, Korea)

¹Invited paper published in IJPHM (www.ijphm.org)

Condition Based Maintenance of Low Speed Rolling Element Bearings using Hidden Markov Model – Guru Prakash¹, Sriram Narasimhan², Mahesh Pandey³ (^{1,2,3}University of Waterloo, Canada)

Paper Session 11A: Railway PHM

Thursday, 1:15 – 3:00, Room: St. Petersburg 2

Session Chair: Ian Jennions (Cranfield University)

Combination of Data-driven Feature Selection Methods with Domain Knowledge for Diagnosis of Railway Vehicles – Bernhard Girstmair¹, Andreas Haigermoser², Justinian Rosca³ (^{1,2}SIEMENS AG, Austria; ³SIEMENS Corporate Technology)

A Reliability-based Prognostics Framework for Railway Track Management – Juan Chiachío¹, Manuel Chiachío², Darren Prescott³, John Andrews⁴ (^{1,2,3,4}University of Nottingham, UK)

Some Influencing Factors for Passenger Train Punctuality in Sweden – Carl-William Palmqvist¹, Nils O. E. Olsson², Lena Winslott Hiselius³ (^{1,2,3}Lund University, Sweden; ²Norwegian University of Science and Technology, Norway)

Anomaly Detection and Severity Prediction of Air Leakage in Train Braking Pipes – Wan-Jui Lee¹ (¹Dutch Railways, Delft University of Technology, the Netherlands)

Paper Session 11B: Prognostics I

Thursday, 1:15 – 3:00, Room: St. Petersburg 3

Session Chair: Abbas Chokor (Seagate Technologies)

Remaining Useful Life prediction method using an observer and statistical inference estimation methods – Toufik Aggab¹, Frédéric Kratz², Pascal Vrignat³, Manuel Avila⁴ (^{1,2}INSA CVL, France; ^{3,4}Orleans University, France)

HPPN-based Prognosis for Hybrid Systems – Pauline Ribot¹, Elodie Chanthery², Quentin Gaudel³ (^{1,2}LAAS-CNRS, Université de Toulouse, France; ³Easymile, France)

PFsuper: Simulation-Based Prognostics to Monitor and Predict Sparse Time Series – Javier Echaz¹, Andrew Gardner²,

¹Invited paper published in IJPHM (www.ijphm.org)

Thursday, October 5, 2017

Panel Sessions	Technology Demos	Location	Time
St. Petersburg 1	Williams & Demens		
Registration			7AM – 12PM
Continental Breakfast		Location: Grand Bay Ballroom & Foyer	7:30 – 8:00
Opening Remarks		Location: Grand Bay Ballroom	
Luminary Presentation: Gilbert Haddad (<i>Sparkcognition</i>) “Digital Transformation Across Industries: Is PHM only for Industrial Assets?”			8:00 – 8:45
Panel Session 8: Corrosion Assessment and Remediation <i>Edward Manns (NACE)</i>	Reserved for PHM Conference		8:45 – 10:15
Break		Location: St. Petersburg Foyer	10:15 – 10:30
Panel Session 9: PHM for Human Assets <i>Wolfgang Fink (University of Arizona)</i>	Reserved for PHM Conference		10:30 – 12:00
Lunch on your own PHM18 & PHME18 Planning Meeting (12:30 – 1:15)		Location: Harbor View	12:00 – 1:15
Panel Session 10: Data Analytics in Commercial Aviation <i>Rhonda Walshall (UTC Aerospace Systems)</i>	Reserved for PHM Conference		1:15 – 3:00
Break		Location: St. Petersburg Foyer	3:00 – 3:30
Panel Session 11: Fielded Systems Lessons Learned <i>Andy Hess (The Hess PHM Group)</i>	Reserved for PHM Conference		3:30 – 5:00
Closing Remarks		Location: St. Petersburg 1	5:00 – 5:30

Ryan R. Curtin³, Nikolaos Vasiloglou⁴, George Vachtsevanos⁵
 (^{1,2,3,4}Symantec Corporation; ⁵Georgia Institute of Technology)

A Condition Based Maintenance Implementation for an Automated People Mover Gearbox – Ali Ashasi-Sorkhabi¹, Stanley Fong², Guru Prakash³, Sriram Narasimhan⁴
 (^{1,2,3,4}University of Waterloo, Canada)

Paper Session 12A: Electronics PHM

Thursday, 3:30 – 5:00, Room: St. Petersburg 2

Session Chair: Jeff Bird (TECNos Consulting Services)

Application of a Relative Humidity Sensor for Monitoring Water Vapor Concentration inside Enclosures – Brian Hatchell¹, Eric Gonzales², Anton Sinkov³, Lorenzo Luzi⁴, Azem Cakerri⁵
 (^{1,2,3,4}Pacific Northwest National Laboratory; ⁵U.S. Army ARDEC)

Prognosis of Connector Disconnection Using a Canary-Based Approach – Xinyu Du¹, Atul Nagose², Aaron Bloom³, Timothy Julson⁴ (^{1,2,3,4}General Motors)

Impact of Modulation Frequencies on the Lifetime of Power Semiconductor Modules for EV Applications – Quentin Gestes¹, Nicolas Degrenne² (¹Ecole Normale Supérieure de Rennes, France; ²Mitsubishi Electric R&D Centre Europe, France)

An Observer-based On-line Electrolytic Capacitor Health Monitoring System – Laurent Foubé¹ (¹Mitsubishi Electric R&D Centre Europe, France)

Paper Session 12B: Prognostics II

Thursday, 3:30 – 5:00, Room: St. Petersburg 3

Session Chair: Stephen Adams (University of Virginia)

Spatio-temporal Probabilistic Modeling Based on Gaussian Mixture Models and Neural Gas Theory for Prediction of Criminal Activity – Francisco Jaramillo¹, Vanessa Quintero², Aramis Pérez³, Marcos Orchard⁴ (^{1,2,3,4}Universidad de Chile, Chile)

[†]Invited paper published in IJPHM (www.ijphm.org)

A Comparison of Feature Selection and Feature Extraction Techniques for Condition Monitoring of a Hydraulic Actuator – Stephen Adams¹, Ryan Meekins², Peter A. Beling³, Kevin Farinholt⁴, Nathan Brown⁵, Sherwood Polter⁶, Qing Dong⁷
 (^{1,2,3}University of Virginia; ^{4,5}Luna Innovations Inc.; ^{6,7}Naval Surface Warfare Center)

Improvement of a Hydrogenerator Prognostic Model by using Partial Discharge Measurement Analysis – Mélanie Lévesque¹, Normand Amyot², Claude Hudon³, Mario Bélec⁴, Olivier Blancke⁵ (^{1,2,3,4}Institut de Recherche d'Hydro-Québec, Canada; ⁵École de Technologie Supérieure, Canada)

A Bi-Level Weibull Model with Applications to Two Ordered Events – Shuguang Song¹, Hanlin Liu², Mimi Zhang³, Min Xie⁴
 (¹The Boeing Company; ^{2,4}City University of Hong Kong, Hong Kong SAR; ³University of Strathclyde, UK)

[†]Invited paper published in IJPHM (www.ijphm.org)



Mobile App

The PHM Conference will be using the Whova mobile app this year. Easily access the most up-to-date agenda information, read full PDF versions of all papers, connect with other attendees, and much more using the free app on your phone or tablet. Get “Whova” from the App Store or Google Play and sign in with your e-mail account. Search for the **PHM2017** event and, if prompted, use passcode **phmsociety**.

http://whova.com/portal/phm_201710



Doctoral Symposium

Monday, 8:00 – 5:15, Room: Bayboro

Symposium Chair: Jamie Coble (Univ. of Tennessee, Knoxville)

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. The panelists for the DS are:

Ian Jennions (*Cranfield University*)

Chetan Kulkarni (*NASA*)

Ravi Rajamani (*drR2 consulting*)

Michael Sharp (*NIST*)

Doctoral Symposium Session 1

Monday, 9:15 – 11:50, Room: Bayboro

A New Approach to High Impedance Fault Detection and Location for Distribution Systems – Roghieh Abdollahi (*Clemson University*)

Development of Deep Learning Based Prognostics for Rotating Components – Jason Deutsch (*University of Illinois, Chicago*)

Fleet Prognostics and Health Management – A General Process Model for Data-Driven Fleet Analytics – Carolin Wagner (*University of Münster*)

Doctoral Symposium Session 2

Monday, 1:00 – 2:40, Room: Bayboro

Probabilistic Life Prediction and Prognostics-Based Maintenance Optimization for Gas Pipelines – Yuhao Wang (*Arizona State University*)

Vibration-Based Fault Detection and Quantification for Primary Flight Control Electro-Mechanical Actuators – Mohamed Ismail (*Institute of Flight Systems, German Aerospace Center (DLR)*)

Doctoral Symposium Session 3

Monday, 3:00 – 5:15, Room: Bayboro

Enhanced System Health Assessment Using Adaptive Self-Learning Techniques – Yuan Di (*University of Cincinnati*)

Development and Application of Advanced Data-Driven Methods for Prognostics and Health Management of Industrial Components under Scarce Degradation Information – Francesco Cannarile (*Politecnico di Milano*)

Career Fair

Career Fair

Tuesday, 10:00 – 12:00

Locations: Sponsors/Exhibition Area and Skyway & Pier Rooms

Follow-up Discussions and 1:1 Interviews

Tuesday, 1:00 – 5:00 and Wednesday, 9:00 – 12:00

Locations: Skyway & Pier Rooms

Are you still looking for a career opportunity in PHM? The PHM Society can help you to meet your next employer at the Career Fair session on October 2–5, 2017!

The PHM Career Fair is an exposition for PHM employers to meet with prospective job seekers. This year the PHM Society is holding a Career Fair within the 9th Annual Conference at Saint Petersburg, Florida to enable recruiters and job seekers the opportunity to meet and conduct interviews. Come meet and talk with growing companies hiring in PHM!

The career Fair is FREE and OPEN to all registered PHM17 conference participants and recruiters.

Candidates of all ages, all levels of experience, and all industries are encouraged to attend.

Candidates can email their resumes prior to the career fair to: careerfair2017@phmconference.org in order to arrange and schedule interviews with recruiters.

Recruiters will be onsite to interview and accept resumes for full-time, part-time and internship positions.

Recruiters must register for the conference.

For further details or questions on the list participants companies, please enquire at the Registration Desk.

Places are limited and will be allocated on a first come first served basis. Register today to reserve your place! For further details or questions, please contact Abbas Chokor at careerfair2017@phmconference.org.

Smart Manufacturing Standards Workshop

Smart Manufacturing Standards Workshop

Wednesday, 8:45 – 12:00, Room: Bayboro

Workshop Chairs: Brian A. Weiss (NIST) and Donnie Alonzo (ASME)

The goal of this workshop is to build upon previous efforts to identify where the American Society of Mechanical Engineers (ASME) might develop standards and/or guidelines that would make it more efficient, cost-effective, and profitable for every manufacturer, to monitor the health of their overall factory, and not just individual machines – and predict when, where, and how maintenance will be needed. Perspectives from large manufacturers, as well as small and medium-sized manufacturers (SMMs) will be shared, current trends in emerging technologies will be discussed, and initial efforts from a prior workshop will be highlighted.

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.

Tutorial Session 1: Model-Based Prognostics—An Introduction

Tuesday, 1:15 – 3:00, Room: St. Petersburg 3

Indranil Roychoudhury

SGT, NASA Ames Research Center

Abstract: This tutorial will cover the basics of model-based prognostics, and include concepts such as modeling approaches, estimation and prediction algorithms, and how uncertainty is represented and quantified. Other topics covered will include structural model decomposition, system-level prognostics, prognostics of hybrid systems, and distributed prognostics. Several case studies, such as water recovery systems to the prediction of safety margins in the national airspace system will be used to explain different concepts of prognostics and demonstrate their application to real-world systems.

Presenter Bios: Dr. Indranil Roychoudhury received the B.E. (Hons.) degree in Electrical and Electronics Engineering from Birla Institute of Technology and Science, Pilani, Rajasthan, India in 2004, and the M.S. and Ph.D. degrees in Computer Science from Vanderbilt University, Nashville, Tennessee, USA, in 2006 and 2009, respectively. Since August 2009, he has been with SGT, Inc., at NASA Ames Research Center as a Computer Scientist. His research interests include hybrid systems modeling, model-based diagnostics and prognostics, distributed diagnostics and prognostics, and Bayesian diagnostics of complex physical systems. Dr. Roychoudhury is a member of the Prognostics and Health Management Society and the AIAA and a Senior Member of the IEEE.

Tutorial Session 2: Design, Development, and Testing of PHM Software

Tuesday, 3:30 – 5:00, Room: St. Petersburg 3

Chris Teubert

NASA Ames Research Center

Abstract: This tutorial will describe the process of designing, developing, and testing PHM software, from the definition of requirements to deployment and maintenance. The emphasis will be on the design and creation of the software product, not the PHM algorithms. Description will include real-life examples from the Diagnostics and Prognostics group at NASA Ames Research Center for the creation of a prognostics application leveraging the Generic Software Architecture for Prognostics (GSAP). Topics covered include selection of software development processes, requirement definition and management, software architecting, design, testing, and maintenance for PHM Applications. The tutorial will include open discussions where attendees are encouraged to provide input from their experiences with PHM application design. Following this tutorial, attendees should have a better understanding of the process of creating PHM applications, with recommendations and advice from individuals experienced with PHM application design.

Presenter Bios: Christopher Teubert is a software engineer and group lead of the Diagnostics and Prognostics group at NASA Ames Research Center. He specializes in the application of prognostics algorithms and the design of prognostics applications. He is also the principal investigator for the Generic Software Architecture for Prognostics (GSAP) and Prognostics as a Service (PaaS) projects. Christopher received his B.S. in Aerospace Engineering from Iowa State University in 2012 and is currently working on his M.S. in Computer Science and Engineering at Santa Clara University. Christopher worked as a research engineer with Stinger Ghafarian Technologies (SGT) at NASA Ames Research Center from 2012-2016 and has worked as a civil servant at NASA Ames since 2016.

Tutorial Session 3: Electrical Power Systems Condition Monitoring for Improved Electronic Systems Health Management & System Resilience

Thursday, 8:45 – 10:15, Room: St. Petersburg 3

Patrick Kalgren

Singularity – Intelligence Amplified

Abstract: Electrical power generation, conditioning, distribution, and management systems are critical to full operational capability of airborne, land, sea, and space systems. Prognostics and health management technologies offer the opportunity to decrease operating costs and increase availability, dependability, efficient utilization, and resilience of these critical infrastructure systems. This tutorial explores technologies and strategies to enable condition awareness and ensure reliable operations; discusses technical progress made in the recent past for electronic power systems health management, considers practical applications of the new technologies, and suggests strategies to foster industry accep-

tance and adoption of PHM capability in support of increasingly complex grid and microgrid energy solutions.

Presenter Bios: Patrick W. Kalgren is a founding partner and the manager of research & engineering at Singularity – Intelligence Amplified. He has a successful background in research and development of new technologies for electronic and power systems health management, self-aware processing systems, and decision support applications. Patrick's contributions in electronic system prognostics and health management and novel data fusion and reasoning, combining physics-based and data driven techniques for PHM, have yielded two awarded patents and four additional patents pending. Mr. Kalgren has published more than 50 papers, and presented invited lectures and tutorials at multiple engineering society events. Patrick has a B.S. degree in Computer Engineering from Penn State University and is a member of Tau Beta Pi, The IEEE, and the American Helicopter Society.

Tutorial Session 4: Deep Learning for PHM

Thursday, 10:30 – 12:00, Room: St. Petersburg 3

Emilien Dupont

Schlumberger

Abstract: Deep Learning has been evolving very quickly over the last few years. This tutorial will aim to give a general introduction to modern Neural Networks and present some of the most recent techniques and why so many great success have come out of Deep Learning in recent years. We will also talk about Deep Learning in the context of PHM and how these techniques can be applied to various problems with time series data. Finally, we will discuss how to blend different types of data (e.g. text, image, time series...) into a single model in the context of predictive maintenance using Deep Learning.

Presenter Bios: Emilien is working as a Data Scientist in the Machine Learning team at the Schlumberger Software Technology and Innovation Center (STIC) in Menlo Park, CA. Emilien graduated with an MS in Computational and Applied Mathematics from Stanford University. Prior to this Emilien obtained a BSc in Theoretical Physics from Imperial College London. He works with applications of Machine Learning, and Deep Learning in particular, to problems in Oil and Gas. He also does research on generative models and variational inference.

Data Challenge Winners

Invited Session: Data Challenge Winners

Wednesday, 8:45 – 10:15, Room: St. Petersburg 1

Session Chair: Justinian Rosca (Siemens)

Similarity-based Approach in Vehicle Suspension System in Fault Detection — Chuang Li¹, Jiayang Liu², Chunhua Tian³, Pengfei Cui⁴, Minghao Wu⁵ (^{1,2,3,4,5}*K2Data, China*)

Ensemble Model Based Fault Prognostic Method for Railway Vehicles Suspension System — Sanhua Li¹, Yuan Tian², Zhaoxiang Jing³, Yizhou Huang⁴, Yalei Yang⁵ (^{1,2,3,4,5}*Innovation Center for Industrial Big Data, China*)

Hybridizing Data-driven and Model-based Approaches for Fault Diagnosis of Rail Vehicle Suspensions — Chan Hee Park¹, Sooho Kim², Junmin Lee³, Dong-Ki Lee⁴, Kyumin Na⁵, Joowhan Song⁶, Byeng D. Youn⁷ (^{1,2,3,4,5,7}*Seoul National University, Republic of Korea*, ⁶*OnePredict Ltd., Republic of Korea*)

Panel Sessions

Panel Session 1: Smart Manufacturing PHM

Tuesday, 8:45 – 10:15, Room: St. Petersburg 1

Session Chair: David Siegel (Predictrionics)

Higher throughput, better product quality, and higher equipment availability, are the potential benefits that a well-designed prognostic and health management (PHM) systems can provide for manufacturing equipment and manufacturing processes. This enticing value proposition, along with a larger industry trend on the topics of Industry 4.0 and Smart Factory are sparking an increasing level of interest in PHM related technologies for manufacturing applications. This panel brings together a diverse group of speakers from original equipment manufacturers, end-users/manufacturers, and technology providers to discuss their ongoing PHM related efforts and their current technology and business challenges. Potential applications will be highlighted, such as industrial robot health monitoring, machine tool spindle and ball screw failure prediction, process-level performance monitoring and bottleneck detection, and incorporating machine health with factory-level decision making systems. Lastly, the panelist will share their thoughts on the future direction of manufacturing PHM.

Panelists:

Mohamed AbuAli (Forcam)
Yujie Chen (Caterpillar)
Xiaoning Jin (Northeastern University)
Greg Vogl (NIST)

Panel Session 2: Human Machine Interfaces for Smart PHM

Tuesday, 10:30 – 12:00, Room: St. Petersburg 1

Session Chair: Jeremy Marvel (NIST)

Advancements in technology are dramatically changing the way we interact with our tools, and the face of manufacturing technology is literally changing to accommodate new processes and the technologically savvy operators working in our factories. Designs of user interfaces (UI) have moved significantly from their original function-over-form values. Currently, human-machine interface (HMI) designs are focused on the end-user, specifically how the presentation of system and process PHM is received and acted upon. These new designs take into direct account the ease-of-use, operator feedback and situational awareness, and overall user experience (UX) of working with the system. The goals of modern HMI design are thus focused on enabling the maximization of productivity while minimizing the cognitive demands of the operators. As technologies shift to accommodate new “collaborative” and “smart” philosophies, the nature of HMI is also expected to change to ensure operator interaction is more intuitive, safe, and effective.

The HMI for Effective PHM panel seeks to highlight the current state-of-the-art and metrics of evaluating the performance of HMI toward promoting and maintaining manufacturing situational awareness, and enabling operators to visualize and respond to critical system and process intelligence. The panel will also bring focus to the needs for advancing HMI solutions for the next generation of collaborative and smart technologies, applications, and consumers. The panel consists of experts representing user interface manufacturers, integrators, researchers, and solutions providers, who will share their perspectives on HMI challenges and opportunities for maximizing the effectiveness of UI for system and process PHM.

Panelists:

Shelly Bagchi (NIST)
Radu Pavel (TechSolve)
David Siegel (Predictrionics)

Panel Session 3: Automotive PHM and Emerging Standards

Tuesday, 1:15 – 3:00, Room: St. Petersburg 1

Session Chair: Steven W. Holland (General Motors)

PHM technology has entered production use in the automotive domain and is expected to become increasingly important for 1) Advanced Diagnostics and 2) True Prognostics. The scope of this panel includes the opportunities and barriers to the growth of PHM for commercial automotive and fleet applications. This panel is highly qualified to address the critical role suppliers will need to play in collaboration with the OEMs/Integrators to maximize the value to themselves but more importantly to the end customer. Effective supplier engagement will depend upon emerging standards to reduce proliferation and to manage costs.

Panelists:

Philip Aiello (UPS)
Luis Hernandez (Global Strategic Solutions)
Andre Kleyner (Delphi)
Klaus Sekot (Bosch)
Yilu Zhang (General Motors)

Panel Session 4: PHM for the Electric Power Grid

Tuesday, 3:30 – 5:00, Room: St. Petersburg 1

Session Chair: Avi Gopstein (NIST)

The availability, reliability, and affordability of the electric power grid is critical to any nation's economy. The convergent advances in computing and communications technology, together with the electric power industry's accelerating deployment of renewable generation and storage technologies to meet environmental performance goals, present new opportunities for advanced diagnostics and prognostics to ensure a reliable electric grid. This panel explores case studies in the deployment of advanced diagnostics, health monitoring, and prognostics for electric power distribution systems, and highlights the business strategies and technical requirements for effective programs.

Panelists:

Norman Amyot (Hydro-Quebec)
Jamie Coble (University of Tennessee)
James Hofmeister (Ridgetop Group)
Sameer Vittal (GE Wind)

Panel Session 5: PHM Applications Deployment

Wednesday, 10:30 – 12:00, Room: St. Petersburg 1

Session Chair: Tomasz Pancewicz (GE Aviation)

The scope of modern PHM applications keeps on growing. Currently, numerous organizations from various industries are ready to make use of numerous predictive and diagnostic models at large scales, on fleets of thousands of machines, with many different configurations, operating in different regions, being managed by networks of stakeholders. The purpose of this panel is to discuss the various issues related to the deployment, management and maintenance of successful PHM applications. The panel will focus on how to create better environments for Remote Monitoring and Diagnostic (RM&D) operators, to help them make the best maintenance decisions and what kinds of feedback-loops should be built into our applications. Discussions will include if professional software engineers should be rewriting prototype models created by analytics engineers / data scientists, vs. should the code created by data scientists be allowed on production servers. Maintainability shall be addressed: how to implement, monitor and manage fleets of models at the production-level, so that they're easy to update, fix and replace in the future. Discussions will also include how to shorten the time required from the moment the prototype-level code is ready, until the production-level code is ready, tested and deployed. The questions around the design of production-level IT

PHM systems and processes turn out to be far from trivial where this panel aims to foster constructive conversations to solve these challenges.

Panelists:

Neil Eklund (*Analamat*)
Juan Lopez (*Boeing*)
Mikhail Roshchin (*Siemens*)
Dan Stair (*Cazena*)
Sameer Vittal (*GE Power*)

Panel Session 6: PHM in Railway Maintenance

Wednesday, 1:15 – 3:00, Room: St. Petersburg 1

Session Chair: Parham Shahidi (PARC)

Railroads play an essential role in today's global economy. As the most efficient land-based mode of transport for freight and the most reliable commuting method for passengers, both freight and passenger rail enable economies to operate reliably, safely and cost efficiently. Given the global pervasiveness of the railroads, making this transportation mode even more reliable and efficient is of paramount importance.

Emerging technologies such as Machine Learning and Big Data hold promise to unlock greater utilization by evolving existing maintenance practices towards condition-based maintenance. Mechanical assets such as locomotives and railcars as well as infrastructure assets such as tracks will benefit from this change, as maintenance and impending failure become predictable. Successful implementations include monitoring track geometry/rail condition, brake systems, and wheel health. While the predictive capabilities are improving, two important factors still require more attention for the success of Railway PHM. These include the data acquisition pipeline and the creation of value chains to offset initial investment costs and drive industry wide implementation.

This panel is made up of experts from industry and research to offer insight into both the practical and theoretical aspects implementing PHM in railroad operations. The panelists will present their unique backgrounds and discuss their experiences with Railway PHM projects and the impacts they have made. The panel will also include a discussion about the future of Railway PHM, where the panelists see the most pressing need for improvements, and where the greatest opportunities are.

Panelists:

Brad Hopkins (*Amsted Rail*)
Milad Hosseini pour (*Amtrak*)
Wan-Jui Lee (*Dutch Rail*)
Raphael Pfaff (*FH Aachen*)
David Siegel (*Predictrionics*)

Panel Session 7: PHM Education and Standards

Wednesday, 3:30 – 5:00, Room: St. Petersburg 1

Session Chairs: Jeff Bird (TECNos) and

Ravi Rajamani (drR² consulting)

Forum link: <http://www.phmsociety.org/forum/592>

One of the PHM Society's objectives is the advancement of PHM as an engineering discipline which includes standards and education. Panels on standards in development and what is needed have been conducted and documented in past conferences and a Society forum exists for exchanges (link above). SAE International as a Technical Partner has greatly contributed to these activities. The PHM Society is also a member of the US Technical Advisory Group of the ISO TC108 that covers diagnostics and prognostics.

How do standards and education come together for the PHM community? Both are enablers for individual and organizational achievement. This panel aims to examine existing methods and

issues for advancing standards education in the PHM domains. Three perspectives on the body of knowledge are sought for discussion with the audience:

Conventional standards organizations (open and commercial?)
Industry (internal closed within supply chains?)
Academia (open and lifelong learning?)

The panel will address generation, availability and renewal of the bodies of PHM knowledge with proprietary, commercial, supply chain realities. We will post to the Society Forum the Background and Challenges presentation in the summer to help the panelists and audience to prepare. Each panelist will conclude their presentation with three challenges to the audience (and PHM world) to salt the open discussion.

Panelists:

Duncan Chase (*Rolls Royce*)
Patrick Dallosta (*Defense Acquisitions University*)
Logen Johnson (*SAE International*)
Karl Reichard (*Pennsylvania State University*)
Brian Weiss (*NIST*)

Panel Session 8: Corrosion Assessment and Remediation

Thursday, 8:45 – 10:15, Room: St. Petersburg 1

Session Chair: Edward Manns (NACE)

Corrosion is a major concern for DoD and industry as equipment age and become prone to corrosion processes. Losses due to corroding aircraft, transportation systems, oil and gas, industrial processes and many other sectors of our economy amount to billions of US dollars each year. It is imperative that new technological developments be advanced to mitigate the detrimental effects of corrosion. R&D is focusing on new coating materials to prevent corrosion as well as on novel corrosion sensing devices and means to detect and predict the extent of corrosion on critical structures and surfaces.

This panel session will examine the current status of corrosion prevention and mitigation technologies. The impact of corrosion processes on the integrity of critical equipment and processes in the oil and gas, transportation, aerospace and other industrial sectors. The panel members will present the state of the art and debate solution options.

Panelists:

Bernard Laskowski (*Analamat*)
Brian Manty (*MB-TSI*)
Rae Marie Mattis (*NACE*)
George Vachtsevanos (*Georgia Tech*)
Frank Zahiri (*US Air Force*)

Panel Session 9: PHM for Human Assets

Thursday, 10:30 – 12:00, Room: St. Petersburg 1

Session Chair: Wolfgang Fink (University of Arizona)

Predictive Health Management (PHM) originated in the Aerospace Industry, basically trying to predict when what part would fail for what reason(s) to make (preventive) maintenance more efficient and cost-effective. This panel discusses contributions in the fields of wearable smart sensors, sensor-data-fusion, machine learning and data mining, prediction and diagnosis, and electronic health records and databases - all in the context of prognostics and health management for human performance on Earth and in Space. Moreover, this panel builds on the discussions of the experience and processes encountered/created by the panelists and highlights some specific challenges, needs, and wants with respect to the development and implementation of standards and guidelines pertaining to PHM in the area of human assets. This diverse group of panelists present their standards and guidelines perspectives on PHM for human assets. Conversations will include PHM's current

and envisioned applications within general healthcare, sports/athletes, theatre, and space environments along with how the needs, data stream, and supporting PHM tools, can be better designed, developed, implemented, integrated, verified, and validated to impact smart healthcare.

Panelists:

Mark Derriso (US Air Force)
Dragan Djurdjanovic (University of Texas)
Wolfgang Fink (University of Arizona)
Gordon Hirschman (Vivonics)
Thurmon Lockhart (Arizona State)

Panel Session 10: Leveraging Data Analytics for Digital Strategies in Commercial Aviation

Thursday, 1:15 – 3:00, Room: St. Petersburg 1

Session Chair: Rhonda Walthall (UTC Aerospace Systems)

The role of Data Analytics in aircraft health monitoring, predictive maintenance and inventory optimization is in the forefront of nearly every conversation about digital strategy and the projected growth of the commercial aviation aftermarket. The key stakeholders in this discussion are the Operators, OEMs, MROs, and Suppliers. This panel builds on the discussion and experience of these stakeholders in leveraging Data Analytics to support their initiatives for legacy aircraft and new technology aircraft.

Panelists:

Craig Amadeo (Delta)
Jayant Sen Gupta (Airbus)
Steve King (Rolls Royce)
Ken Nishiwaki (All Nippon Airways)
Sven Pörschmann (Lufthansa Technik)
Ginger Shao (Honeywell)

Panel Session 11: Fielded Systems Lessons Learned

Thursday, 3:30 – 5:00, Room: St. Petersburg 1

Session Chair: Andy Hess (The Hess PHM Group)

Several long-term career practitioners in the fields of PHM and CBM+ will share their experiences, observations, and important lessons learned as part of this distinguished panel of experts. Much can be learned from the requirements generation, development, Verification and Validation, implementation, maturation, fielded use, fleet support, and enterprise-wide use of real world PHM systems. Just the development of the individual capabilities that make up a comprehensive and fully integrated PHM system; provides a large number of lessons learned - both good and bad. A recently evolving important focused area will also be explored around the question: "just who really owns the data that these systems produce". These issues need to be discussed, documented, and viewed across the many industry sectors that are fielding PHM systems. Short presentations will be given by all panel participants that describe their particular topic area and experiences within the PHM/CBM+ domains. An open panel discussion will follow to explore some of these identified specific issues and concerns.

Panelists:

Duncan Chase (Rolls Royce)
Steve Holland (General Motors)
Allen Jones (NAVAIR Propulsion and Power)
Michele Kochoff Platt (AVNIK Defense Solutions)
Woody Polter (Naval Surface Warfare Center)
Ginger Shao (Honeywell)



Keynote Speakers

Keynote #1: Electric Aircraft: The Future of Flight, or a Fleeting Fancy?

Tuesday, 12:00 – 1:15

Room: Grand Bay Ballroom

Ravi Rajamani
drR² consulting



Abstract: Electric propulsion for manned flight is growing around the world with both established companies and startups competing to be the first to offer viable solutions. In this keynote we will discuss the history of electric propulsion and see how various key technologies are evolving, in as non-technical a manner as possible. Starting from lighter-than-air craft in the nineteenth century to blended-wing bodies using cryogenic components in the twenty-first, this history wends its way through solar, all-electric, and hybrid-electric propulsion architectures. In spite of various barriers to its success, this sector is growing furiously and we will try to understand why this is happening.

Speaker Bio: Dr. Ravi Rajamani established *drR² consulting* in 2016 to leverage more than 25 years of experience and expertise in data analytics and model-based design to help clients in aerospace and other industries solve diagnostics and prognostics issues. Prior to this, Ravi was an Engineering Director with Meggitt for 5 years, following an 11-year tenure with United Technologies Corporation, first at the Research Center, and then with its Pratt & Whitney division. Before that he was with the General Electric Company for 10 years. He was closely associated with its Research Center and its Power Generation business; but worked with all other businesses as well. Ravi has worked in the area of controls and diagnostics of gas turbines and other complex systems, primarily using model-based and data-based analytical techniques. Ravi has a BTech (ME) from IIT Delhi, an MS (Automation) from IISc, Bangalore, a PhD (EE) from the University of Minnesota, and an MBA from the University of Connecticut. He has produced a book on electric propulsion; four book chapters and is working on two more; numerous papers in refereed journals and conference proceedings; has been invited to speak at conferences and institutions around the world; and has several patents to his name. He is active within SAE's Propulsion Health Management (E-32), Integrated Vehicle Health Management (HM-1) committees, and various steering groups: IVHM, Electric-Aircraft, and Digital. He is also active in the PHM Society, serving on its board of directors, and he was the general chair of the 2014 European PHM conference in Nantes, France. Ravi is a Visiting Professor at Cranfield University, UK. He is a chartered engineer and a fellow of the IMechE in the UK. He also serves as a board member of the Edison Tech Center in Schenectady.

Keynote #2: Issues and Opportunities in Automotive PHM

Wednesday, 8:00 – 8:45

Room: Grand Bay Ballroom

Steve Holland
General Motors



Abstract: The advent of predictive analytics technology coupled with high-bandwidth telematic access to vehicles has opened the door for advancements in automotive PHM. This new paradigm offers a path to enhance diagnostic development and implementation as well. Prognostics has demonstrated the ability to dramatically improve perceived reliability from the customer's point

of view as well as providing a host of other potential benefits. For example, the same type of information that is useful for detecting the onset of specific failure modes can also be used to enhance the vehicle validation process and to more effectively manage field issues. The need becomes ever greater as vehicles are equipped with more sophisticated control systems and advanced safety features. In the future, automotive suppliers will need to play an increasingly important role in the cost-effective implementation of prognostics by providing "health-ready components" to the OEMs. Emerging standards under development within SAE are expected to facilitate that eventuality.

Speaker Bio: Steven W. Holland is a Research Fellow at GM Global R&D and is currently responsible for technology strategy in Vehicle Health Management. He has been with GM for over 45 years and has held a wide variety of technical and executive positions in both R&D and Manufacturing Engineering. He is a Fellow of IEEE and a Member of SAE. Steve is active in SAE's HM-1 IVHM Standards Committee & the IVHM Steering Group. He is a member of the Prognostics & Health Management (PHM) Society Board of Directors & their International Scientific Committee. He has served on a variety of industry, academic and government advisory boards and is a registered professional engineer. Mr. Holland holds technical degrees from Kettering & Stanford Universities.

Luminary Presentations

The Luminary sessions are tagged as a keystone event for the 2017 PHM Conference. In these sessions, experts from different domains provide new insights on the pervasive use of health management methods and technologies. In 2017, the luminary session will take place on the mornings of Tuesday, Wednesday, and Thursday. These sessions are intended not only to highlight the inter-disciplinary aspect of health management, but also promote an interchange of ideas that span diverse application domains.

Luminary Presentation #1: Uncertainty in Hazard Forecasting; Or Where Will You Go When the Volcano Blows?

Tuesday, 8:00 – 8:45

Room: Grand Bay Ballroom

Elaine Spiller

Marquette University



Abstract: It is typical for individuals and communities to internalize the potential threat level of hazards based on previous experience and history. The idea that something of THAT scale couldn't possibly happen because it has never happened before is dangerous. It neither captures the inherent randomness (aleatoric uncertainty) of geophysical phenomenon nor the idea that devastating events are governed by so-called tail behavior. Their rare nature makes such events nearly impossible to forecast, if forecasts are based only on previous observations. To capture rare events, we must rely on complex physical and mathematical models that often require significant computational resources to exercise. These models come with their own sets of assumptions and approximations adding layers of epistemic uncertainty to hazard forecasts. Our approach to probabilistic hazard forecasting allows for rapid uncertainty quantification and can be quickly updated with new data or to reflect emerging scenarios. This approach constitutes a dramatic improvement in scientifically-based decision support.

Speaker Bio: Elaine Spiller is an Associate Professor of Mathematics and Statistics at Marquette University in Milwaukee, Wisconsin. She received her BS in Applied Mathematics from the University of Colorado in 2000 and her PhD in Applied Mathematics from Northwestern University in 2005. Her thesis work focused on studying

rare events in nonlinear lightwave systems. She was a postdoctoral fellow at the Statistical and Applied Mathematical Sciences Institute (SAMSI) from 2006-2008. At that point her interest in rare events transitioned to geophysical hazards applications. Elaine and colleagues have pioneered a strategy to make fully probabilistic geophysical hazard maps.

Luminary Presentation #2: Digital Transformation Across Industries: Is PHM only for Industrial Assets?

Thursday, 8:00 – 8:45

Room: Grand Bay Ballroom

Gilbert Haddad

Sparkcognition



Abstract: Big Data and Analytics and Digital Transformation have become some of the hottest topics in different industries over the last few years. There is a myriad of new data sources, cost of collecting and storing has declined significantly, and there is a new 'data rush' to extract the most value while driving business impact. Industrial companies have embraced PHM for more than a decade now, and substantial efforts have been made to leverage the data to reduce downtime, increase efficiency, reduce costs, etc.. Other industries have started to adopt this recently under the name of 'data science', 'big data and analytics', or 'digital transformation'. What can those industries learn from PHM? What are the communalities and differences? Are the lessons learned in PHM applicable to financial services? Where are we going from here and what are the missing gaps? These are some of the questions that will be addressed while drawing on the experience from different industries.

Speaker Bio: Gilbert Haddad has participated in shaping the Digital Transformation in multiple industries. Gilbert currently works with hedge funds on data science for investments, and advises a tech startup with their data science initiatives. Most recently Gilbert was a Data and Analytics Director for a multi-billion dollar fund where he led their big data and analytics organization. Prior, Gilbert was with Schlumberger, where he held the positions of Director of Digital Transformation and Global Analytics Manager. During both assignments, he led the strategy, development, execution, delivery and monetization of PHM applications within the company. Before Schlumberger, Gilbert was a Lead Data Scientist for GE Software and Analytics. He earned his Bachelor of Engineering in Mechanical Engineering from the American University of Beirut in Lebanon. He also holds a Master of Science in Mechanical Engineering from the University of Wisconsin-Madison and a Doctorate of Philosophy from the PHM center at the University of Maryland, College Park.

Social Program

Sponsor Exhibits

Throughout Conference

Opening Welcome Reception

Monday, 5:30 – 7:30, Location: Poolside

Cocktail Reception with Posters

Tuesday, 6:00 – 7:30, Location: Grand Bay Ballroom

PHM Conference Banquet

Wednesday, 6:00 – 10:00, Location: Museum of Fine Arts (for guest tickets, please see Registration Desk)

The banquet is Greece-themed and features a night of Dionysian pleasures, including ELLADA—America's Favorite & Best Live Greek Band. Practice your syrtaki dance moves and dress like your favorite demi-god, or just bring your favorite Greek outfit (Parpou hat, fez, skull cap, etc.).

PHME 2018 Europe ***Utrecht, Netherlands, July 3 – 6, 2018***



Fourth European Conference of the Prognostics and Health Management Society
The Muntgebouw, Utrecht, Netherlands

www.phm-europe.org



PHME2018 & PHM2018 Planning Meeting:
Thursday, October 5th
12:30 – 1:15 (during lunch)
Harbor View Room



**Volunteers
Needed!**

PHM 2018 ***Philadelphia, PA, September 24 – 27, 2018***



Tenth Annual Conference of the Prognostics and Health Management Society
DoubleTree by Hilton Hotel Philadelphia Center City, Pennsylvania

www.phmsociety.org



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Poster Presentations: Tuesday 6:00 – 7:30

Grand Bay Ballroom (During Cocktail Reception)

Doctoral Symposium Posters

- A New Approach to High Impedance Fault Detection and Location for Distribution Systems — Roghieh Abdollahi (*Clemson University*)
- Development of Deep Learning Based Prognostics for Rotating Components — Jason Deutsch (*University of Illinois, Chicago*)
- Fleet Prognostics and Health Management – A General Process Model for Data-Driven Fleet Analytics — Carolin Wagner (*University of Münster*)
- Probabilistic Life Prediction and Prognostics-Based Maintenance Optimization for Gas Pipelines — Yuhao Wang (*Arizona State University*)
- Vibration-Based Fault Detection and Quantification for Primary Flight Control Electro-Mechanical Actuators — Mohamed Ismail (*Institute of Flight Systems, German Aerospace Center (DLR)*)
- Enhanced System Health Assessment Using Adaptive Self-Learning Techniques — Yuan Di (*University of Cincinnati*)
- Development and Application of Advanced Data-Driven Methods for Prognostics and Health Management of Industrial Components under Scarce Degradation Information — Francesco Cannarile (*Politecnico di Milano*)

Sincere Thanks to All Review Managers and Reviewers

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CALL FOR PAPERS

Special Issue of the International Journal of Prognostics and Health Management Standards for Prognostics and Health Management

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The International Journal of Prognostics and Health Management (IJPHM) is the premier *online open access journal* related to multidisciplinary research on Prognostics, Diagnostics, and System Health Management. This special issue is focused on the development, implementation, and evolution of standards, guidelines, and best practices relevant to condition monitoring, diagnostic, and prognostic technologies across a range of operational domains.

The development and implementation of standards have become a means of promoting more clear and accurate communication among disparate groups of people and technology. Some standards have become regulatory where they are adopted and enforced by organizations to ensure specific levels of capability or sufficiency. This not only provides benefit to the standards' end-user community, this also provides value to other stakeholders within the supply chain (whether they are upstream suppliers or downstream customers). Conversely some standards are non-regulatory where they are typically developed by a community of eventual end-users and then subsequently, and voluntarily, adopted by the same group. Some standards may be considered rigid in definition and implementation while others are less so. Standards-related activities also include the development of guidelines and best practices; Their proliferation and implementation have afforded end-users with sufficient flexibility to mold the guidelines and best practices to their specific operations, needs, and wants.

Standards, whether regulatory or not, have proven successful in multiple domains. They have been, and continue to be, developed in a range of industries including aerospace, agriculture, automotive, consumer electronics, electric power generation, machine tools, manufacturing, medical, oil & gas, robotics, transportation, and wind energy. The Call for Papers solicits articles on the following:

Topics of Interest:

- Survey papers highlighting existing PHM standards
- Evidence of PHM standards deployments and lessons learned
- Methods to address 'stale' / no longer used PHM standards
- Financial impact and burden of deploying PHM standards
- Standards developed for monitoring, diagnostic, and/or prognostic techniques
- Strategies to increase standards involvement by stakeholders
- Lifecycle of a PHM standard
- Proliferation of a standard(s) throughout a supply-chain
- Standards organizations and their respective areas of focus
- Workforce challenges faced during standards adoption
- Reconciling PHM standards needs and wants of disparate stakeholder groups
- PHM Standards vs. PHM guidelines vs. PHM best practices

Submission Types (papers can range from 4-8 pages in length):

Development Briefs: Development briefs describe an instance of a standard's development, the resultant impacts, and lessons learned with an emphasis on the successes and challenges of the development process and how it influenced the standard's lifecycle.

Industry Case Studies: Case studies are descriptive accounts of standards within operational environments or actual products. Techniques and apparatus used, results obtained, and lessons learned can be included to share experience with the community.

Survey Papers: Survey papers are of a tutorial or review nature covering PHM standards or describe the best current practice, detailed characteristics and performance. These papers cover areas of general interest.

Special Issue Editors: Jeff Bird, jeffbird@rogers.com, Ravi Rajamani, ravi@dr2-consulting.com, Brian A. Weiss, brian.weiss@nist.gov

Submission Instructions: Please submit your manuscripts directly by going to the society webpage and follow instructions for journal submissions. There you will find an option to select the standards special issue.

Invitation to Present: Accepted papers are eligible for presentation at a future Annual Conference of the PHM Society

Deadline for Submission: February 12, 2018

More information is available on the web site: <http://www.ijphm.org>

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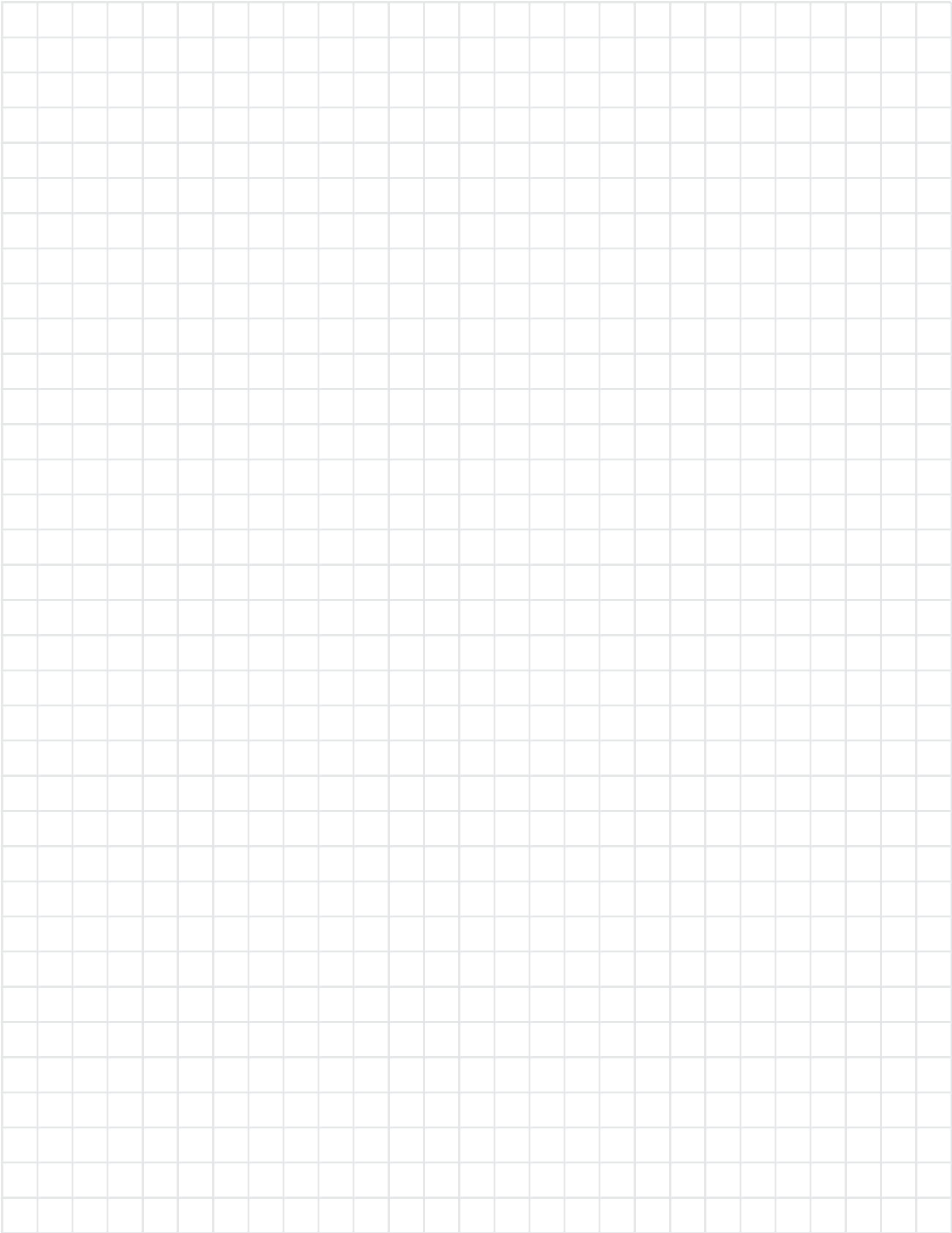
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	<p>The National Institutes of Standards and Technology (NIST), whose mission is to promote U.S. innovation and industrial competitiveness, is actively conducting research in the field of manufacturing PHM, and specifically, delivering methods, protocols, and tools that enhance the efficiency of smart manufacturing systems.</p> 
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	Diag21 is an association that was created in 2009, at the initiative of a group of industrials Aeronautics and Defence. Its internationally oriented, is dedicated to the optimization of testability, diagnosis and prognosis (PHM) of complex systems in the areas of aerospace, land, car, rail and marine. Close to industry needs, diag21 offers exchange and service platforms.
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	The IMS Center is a leading NSF Industry/University Cooperative Research Center (I/UCRC) in the area of Prognostics and Health Management (PHM). The Center has over fifteen years of experience in developing and delivering PHM solutions for a wide-range of applications. IMS Center's mission is to enable products and systems to achieve and sustain near-zero breakdown performance, and transform maintenance data to useful information for improved productivity and asset life-cycle utilization. Since its inception, the Center has conducted over 100 successful industry and NSF supported projects, and has attracted over 80 members from all across the globe. The IMS Center was recently identified as the most economically impactful I/UCRC in NSF's recent study titled Measuring the Economic Impacts of the NSF Industry/University Cooperative Research Centers Program: A Feasibility Study. According to this study, the Center delivered its members a \$846.7 Million in combined benefits over the last ten years.
	IVHM Center —the Integrated Vehicle Health Management (IVHM) Centre at Cranfield University in the UK—was established in 2008. It is funded by a number of large companies—Boeing, BAE Systems, Rolls-Royce, Thales and Meggitt—to work on high impact topics. The increasingly important area of IVHM technology informs existing concepts of vehicle maintenance, repair and overhaul by offering a total health check for high-tech, high-value vehicles such as aircraft, ships, high-speed trains and high performance cars.
	MFPT is a non-profit professional society with a 45-year legacy of promoting failure prevention technology. An interdisciplinary technical organization, MFPT is strongly oriented towards the practical application of health management across every engineering sphere. The MFPT community includes professional scientists, engineers, failure analysts, maintenance specialists and others who represent a wide variety of disciplines from government agencies, universities, research institutes and industry.
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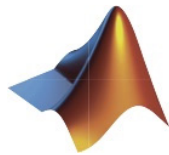


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