

Industry Forum:

Moving from “React and Repair” to “Predict and Prevent”



NIST, Gaithersburg, Maryland, USA
May 8 - May 11, 2018

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Welcome

Welcome to the first-ever *Industry Forum: Monitoring, Diagnostics, and Prognostics* at the National Institutes of Standards and Technology (NIST). We are pleased that you are joining us for what we expect will be an insightful and productive week discussing current trends, successes, challenges, and needs with respect to advanced monitoring, diagnostic, and prognostic technologies to enhance maintenance and control strategies within manufacturing operations.

The manufacturing community has been evolving as new technologies emerge, existing technologies mature, and advanced technologies become accessible to more organizations as costs decrease and integration challenges are addressed. New fault and failure modes emerge as technologies are integrated into an organization’s manufacturing process for the first time, existing processes are being reconfigured to support new products, new sensors are gathering more information than ever before, and analytics offer greater intelligence and awareness. Manufacturers take different approaches, especially between large and small to medium-sized enterprises (SMEs), to deal with these faults and failures. Most manufacturers aim to avoid reactive maintenance – fix equipment after it breaks and interrupts production – as this strategy can present substantial risk and cost. Nearly every manufacturer employs some form of preventive maintenance – change the proverbial oil every 3 months or 3,000 miles – as a way to keep their systems and processes operating within specification. The downside to this strategy is that it sometimes leads to unnecessary cost and downtime if maintenance is done too frequently and it still does not eliminate the prospect of reactive maintenance. Pockets of the manufacturing community are increasing their predictive maintenance capability – plan maintenance activities based upon analyzing specific sensor data that inform upon system and process performance and health - to optimize (ideally) their maintenance activities to minimize both downtime and maintenance costs. Proactive maintenance, intelligent maintenance, and autonomous maintenance are emerging maintenance strategies that present tremendous potential to further minimize equipment and process downtime. With all of these strategies, where each presents its own benefits and challenges, where should a manufacturer begin? No two manufacturers are alike making it unlikely that a single solution will solve every maintenance challenge.

We have designed this *Industry Forum* to offer you an opportunity to hear directly from the diverse stakeholders who see the value in advancing monitoring, diagnostic, and prognostic technologies. The first three days of presentations and panels will feature various perspectives including: Large to small manufacturers will present on their successes and challenges with respect to their maintenance strategies; technology integrators and technology developers will highlight emerging hardware and software capabilities to enhance awareness; and researchers will discuss how their break-throughs in emerging technology, and verification and validation techniques will expand the boundaries as to what is possible for monitoring equipment and process health in the factory.



In addition to our presentations and panel sessions, we have lined up three outstanding plenary talks:

- Michael Molnar, *Founding Director of the Office of Advanced Manufacturing*, will present on how Manufacturing USA is creating vast research networks to solve some of the industry’s most challenging problems.
- Albert Wavering, *Chief of the Intelligent Systems Division*, will share NIST’s smart manufacturing research efforts focused on developing measurement technologies, performance metrics, test methods, and tools to enhance industry competitiveness.
- Jaime Camelio, *Chief Technology Officer of the Commonwealth Center for Advanced Manufacturing (CCAM)*, will discuss process monitoring and diagnosis as he works to build up Virginia’s manufacturing capabilities with CCAM industrial partners.

The final day of the Forum, Friday, will be devoted to building up an ASME-led standards community focused on advancing monitoring, diagnostics, and prognostics for manufacturing operations. ASME and NIST personnel will guide the participants in examining specific priority areas and detailing the next steps to generate and deliver guidelines to industry that enhance a manufacturer’s ability to design, deploy, verify, and validate their maintenance-related capabilities. We hope you can participate with us in this standards effort.

The entire four-day *Industry Forum* will be summarized in a report that is expected for public release later in 2018. Even if you cannot stay with us for the duration of the event, you can still stay informed on the forum’s output. Likewise, as we actively build up this standards community, we are seeking additional volunteers to offer their time and expertise.

Whether you are from industry, academia, or government, we are confident you will enjoy your week at NIST.

- Brian A. Weiss, *Intelligent Systems Division, NIST*
- Michael P. Brundage, *Systems Integration Division, NIST*



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Industry Forum: Monitoring, Diagnostics, and Prognostics for Manufacturing Operations



MOVING from "REACT and REPAIR" to "PREDICT and PREVENT"

AGENDA: Tuesday, May 8, 2018 (Green Auditorium)

TIME	EVENT/SESSION	PRESENTERS
7:15-4:30	Registration (outside the auditorium)	
8:15-8:30	Introduction and Safety	Brian A. Weiss (NIST - Intelligent Systems Division), Michael Brundage (NIST - Systems Integration Division)
8:30-8:45	Overview of NIST's Engineering Laboratory and Welcome	Kirk Dohne (NIST - Engineering Laboratory)
8:45-9:20	PLENARY: Manufacturing USA: Solving Tough Industry Challenges Through Collaboration	Michael Molnar (NIST - Office of Advanced Manufacturing)
9:20-9:35	<i>BREAK</i>	
9:35 - 11:25	Large Manufacturing Needs and Case Studies - Presentations & Panel	Al Salour (Boeing), Luis Hernandez (Global Strategic Solutions), James Moyne (Applied Global Services)
11:25 - 12:40	<i>LUNCH</i>	
12:40 - 2:30	Small to Medium Manufacturing Needs and Case Studies - Presentations & Panel	Scott Sipe (Mantec), Tom Zbell (Genedge), Thorsten Wuest (West Virginia University), Mark Walker (D2K)
2:30 - 2:45	<i>BREAK</i>	
2:45 - 4:35	Communication and Information Flow to support PHM - Presentations & Panel	Will Sobel (Vimana), Moneer Helu (NIST - Systems Integration Division), Joel Neidig (ITAMCO), Rob Andes (The Knowledge Design Company)
4:35 - 4:55	The Costs and Benefits of Advanced Maintenance in Manufacturing	Doug Thomas (NIST - Applied Economics Office)
4:55 - 5:00	Closing and Departure	Brian A. Weiss (NIST - Intelligent Systems Division)

AGENDA: Wednesday, May 9, 2018 (Green Auditorium)

TIME	EVENT/SESSION	PRESENTERS
7:00-4:30	Registration (outside the auditorium)	
8:00-8:05	Welcome	Brian A. Weiss (NIST - Intelligent Systems Division), Michael Brundage (NIST - Systems Integration Division)
8:05 - 8:35	PLENARY: NIST Smart Manufacturing Programs: Driving Innovation and Reducing Risks of Adoption of New Technologies	Al Wavering (NIST - Intelligent Systems Division)
8:35 - 10:35	Emerging Sensing Technologies to Enable Monitoring, Diagnostics, and Prognostics - Presentations & Panel	Radu Pavel (TechSolve), Brittany Newell (Purdue University), Justinian Rosca (Siemens Corporation), Gregory Vogl (NIST - Intelligent Systems Division), Ed Spence (Machine Instrumentation)
10:35 - 10:50	<i>BREAK</i>	
10:50 - 12:50	Planning and Assessment to Promote Monitoring, Diagnostic, and Prognostic Technologies - Presentations & Panel	Karl Reichard (Penn State University Applied Research Lab), Ananth Seshan (MESA), Kai Goebel (NASA), Miguel Saez (University of Michigan), Jorge Arinez (General Motors)
12:50 - 1:50	<i>LUNCH</i>	
1:50 - 3:20	Monitoring and Analysis Technologies for Prognostics and Health Management (PHM) - Presentations	David Siegel (Predictronic), Nancy Diaz-Elsayed (University of South Florida), Sanket Amberkar (Falconry), Robert Gao (Case Western Reserve University), ChaBum Lee (Tennessee Tech University)
3:20 - 3:35	<i>BREAK</i>	
3:35 - 4:05	Monitoring and Analysis Technologies for Prognostics and Health Management (PHM) - Panel	David Siegel (Predictronic), Nancy Diaz-Elsayed (University of South Florida), Sanket Amberkar (Falconry), Robert Gao (Case Western Reserve University), ChaBum Lee (Tennessee Tech University)
4:05 - 4:25	Emerging Research Efforts	Junmin Lee (Seoul National University), Chan Hee Park (Seoul National University)
4:25 - 4:45	Using Unstructured Work Order Data to Improve Maintenance Procedures in Manufacturing	Michael Brundage (NIST - Systems Integration Division)
4:45 - 5:05	NIST Research on Monitoring, Diagnostics, and Prognostics for Manufacturing Workcells	Brian A. Weiss (NIST - Intelligent Systems Division)
5:05 - 5:10	Closing and Departure	Brian A. Weiss (NIST - Intelligent Systems Division), Michael Brundage (NIST - Systems Integration Division)

AGENDA: Thursday, May 10, 2018 (Green Auditorium)

TIME	EVENT/SESSION	PRESENTERS
7:30-4:30	Registration (outside the auditorium)	
8:30 - 8:35	Welcome Address	Brian A. Weiss (NIST - Intelligent Systems Division), Michael Brundage (NIST - Systems Integration Division)
8:35 - 9:05	PLENARY: CCAM Activities in Process Monitoring and Diagnosis	Jaime Camellio (Commonwealth Center for Advanced Manufacturing)
9:05 - 10:17	Standards and Best Practices - Presentations	Andrew Hess (Hess PHM Group), Ravi Rajamani (drR2), Tom Fiske (Yokogawa), Tom Hedberg (NIST - Systems Integration Division)
10:17 - 10:30	<i>BREAK</i>	
10:30 - 10:50	Standards and Best Practices - Presentations Cont.	Logen Johnson (SAE), Donnie Alonzo (ASME)
10:50 - 11:50	Standards and Best Practices - Panel	Andrew Hess (Hess PHM Group), Ravi Rajamani (drR2), Tom Fiske (Yokogawa), Tom Hedberg (NIST - Systems Integration Division), Logen Johnson (SAE), Donnie Alonzo (ASME)
11:50 - 1:00	<i>LUNCH</i>	
1:00 - 2:15	PHM within the International Manufacturing Community - Presentations	Byeng Youn (Seoul National University), Hyunbo Cho (Pohang University of Science and Technology), Hyunseok Oh (Gwangju Institute of Science and Technology)
2:15 - 3:15	Visualization Tools for PHM - Presentations & Panel	Jeremy Marvel (NIST - Intelligent Systems Division), Sinan Bank (Siemens Corporation)
3:15 - 3:30	<i>BREAK</i>	
3:30 - 4:00	Demystifying Today's AI	Michael Garris (NIST - Information Technology Laboratory)
4:00 - 4:30	Industry AI-- A System Perspective in Machine Learning for Smart Manufacturing and Maintenance	Jay Lee (University of Cincinnati, Center for Intelligent Maintenance Systems)
4:30 - 5:00	Planning for the Future - Building and Leveraging Artificial Intelligence: Panel Discussion	Jay Lee (University of Cincinnati, Center for Intelligent Maintenance Systems), Michael Garris (NIST - Information Technology Laboratory)
5:00 - 5:10	Closing and Departure	Brian A. Weiss (NIST - Intelligent Systems Division), Michael Brundage (NIST - Systems Integration Division)

AGENDA: Friday, May 11, 2018 (Green Auditorium)

ASME Standards Meeting - Monitoring, Diagnostics, and Prognostics for Manufacturing Operations

8:05 – 8:15 - Introduction to ASME's Efforts in Monitoring, Diagnostics, and Prognostics (Brian Weiss / Michael Brundage)

- Motivation for building up this standards community
- Highlighted gaps from June and October 2017 Workshops

• [June 2017 Workshop Report - https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.100-13.pdf](https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.100-13.pdf)

8:15 – 8:30 – Introduction to ASME (Donnie Alonzo/Steve Weinman)

8:30 – 9:00 – Presentation and collection of comments and feedback on Draft Charter for New Subcommittee (Brian

9:10 – 10:00 – BRAINSTORMING #1 Discussion on Areas of Priority / Subcommittee Work Breakdown

This session will feature discussion on the top (6) priority areas that were identified in prior workshops and a determination which of these (6) areas should be discussed in greater detail in the BRAINSTORMING #2

- Standardized Terminology for PHM Guideline on Data and Collection Strategies
- Guideline to Determine What Health Data to Capture and Collection Strategies to Employ
- Guideline to Determine What Sensors and Where they should be deployed to inform on Process/Equipment
- Guideline for implementing sensor data fusion/multi-modal data fusion
- Guideline to Determine When and Where PHM should be added/integrated
- Expand MTConnect/Data Communications

10:00 – 10:15 – BREAK

10:15 – 12:30 – BRAINSTORMING #2 - Work Breakdown Structures and Project Team / Committee Structure

Groups will be formed and will be tasked to further detail a priority area (noted above). This effort will include definition/clarification of key deliverables, specific tasks, and an estimated timeline.

12:30 - 1:30 – LUNCH

1:30 – 2:15 – BRAINSTORMING #3 - Report Back, Interested Parties and Identification of potential Members / Finalizing of Committee Structure and Breakdown

2:15 – 2:30 – RECAP FROM ASME ON NEXT STEPS AND REQUIRED ITEMS FOR MEMBERSHIP (Donnie Alonzo/Steve

2:30 – 2:45 – CLOSING AND DEPARTURE (Brian Weiss, Michael Brundage)



Tuesday, May 8, 2018

Overview of NIST’s Engineering Laboratory and Welcome



Kirk Dohne, *Engineering Laboratory, National Institute of Standards and Technology (NIST)*

Bio: Kirk Dohne is the Associate Director of the National Institute of Standards and Technology’s (NIST’s) Engineering Laboratory, which addresses the measurement and standards needed to support technology-intensive manufacturing, construction, building energy efficiency, and smart grid and cyber-physical systems. The Engineering Laboratory also conducts research to reduce the risks of fire, earthquakes, tornadoes, and other natural and manmade hazards.

Kirk came to NIST in 2001 to assist the Information Technology Laboratory in strategic planning and impact analysis. He then moved to the Engineering Laboratory in 2012. The Engineering Laboratory has staff of approximately 400 people, distributed among five major research divisions, including two divisions primarily focused on advanced manufacturing – the Intelligent Systems Division and the Systems Integration Division. The laboratory’s annual budget is nearly \$100 million.

PLENARY – Manufacturing USA: Solving Tough Industry Challenges Through Collaboration



Michael Molnar, *Office of Advanced Manufacturing, NIST*

Bio: Mike Molnar is the founding director of the Office of Advanced Manufacturing at the National Institute of Standards and Technology, and the Advanced Manufacturing National Program Office, an interagency team which serves as the Congressionally-designated program office for Manufacturing USA – the National Network for Manufacturing Innovation.

Mike joined NIST in 2011. Prior to federal service, Mike had a nearly 30-year industry career in advanced manufacturing, with leadership roles in manufacturing technology development, corporate manufacturing engineering, capital planning, metrology, quality systems, robotics and flexible automation, and computer integrated manufacturing systems. Mid-career Mike served as the manufacturing policy Fellow in the White House Office of Science and Technology Policy.

Mike has been active in engineering professional societies for over thirty years, holding over 70 elected or appointed leadership positions – including President of the Society of Manufacturing Engineers and now Governor of the American Society of Mechanical Engineers. He is a licensed Professional Engineer, Certified Manufacturing Engineer, and was elected Fellow of both ASME and SME. He was recently recognized with the Golden Eagle award from the Boy Scouts of America and the Merchant Manufacturing Medal of ASME/SME.



Large Manufacturing Needs and Case Studies – Presentations & Panel

Al Salour, *The Boeing Company*

Presentation Title: *Monitoring, Diagnostics, and Prognostics for Large Manufacturing Operations*

Bio: Dr. Salour is a Boeing Technical Fellow and the enterprise leader for Network Enabled Manufacturing technologies. He is responsible for a systems approach to develop, integrate, and implement affordable sensor-based manufacturing strategies and plans that provide real time data for factory systems and supplier networks. He is building a model for the current and future Boeing factories by streamlining and automating data management to reduce factory direct labor and overhead support, and promote manufacturing as a competitive advantage. Dr. Salour is a research investigator with national and international premiere universities and research labs. He is a member of the Industrial wireless technical working group with the NIST. Dr. Salour has 30 invention disclosures, 20 patents and 1 trade secret in manufacturing technologies.



Luis Hernandez, *Global Strategic Solutions*

Presentation Title: *Condition Based Maintenance in DoD – Are we there yet?*

Bio: Luis Hernandez is the Managing Director at Global Strategic Solutions LLC. He has 30 years of experience in diagnostic equipment systems engineering along with over 10 years of experience in Integrated Vehicle Health Management (IVHM)/Prognostics and Health Management (PHM) systems applied research. He is actively leading his organization’s contributions to the SAE HM-1 standards development efforts (e.g., JA6268). He holds a B.S. Electrical Engineering degree that he received from Wayne State University and participated in the MBA program at Cal State in Los Angeles.



James Moyne, *Applied Global Services*

Presentation Title: *A Solution Roadmap for Moving from Reactive to Prognostic Technologies in Semiconductor Manufacturing*

Bio: James Moyne is a consultant for standards and technology to the Applied Global Services group at Applied Materials, and an Associate Research Scientist at the University of Michigan, where he received his Ph.D. degree. Dr. Moyne has experience in advanced process control, prediction technology (predictive maintenance, virtual metrology, and yield prediction), and big data technology, focusing on analytics; he is the author of a number of refereed publications and holds patents in each of these areas. He currently co-chairs the Factory Integration Thrust of the International Roadmap for Devices and Systems (IRDS), and well as a number of semiconductor manufacturing standards efforts (SEMI).



Small and Medium Manufacturing Needs and Case Studies – Presentations & Panel



Scott Sipe, *Mantec*

Presentation Title: *The Connected Factory for SMM-Opportunities and Challenges*

Bio: Scott W. Sipe is the Director of Finance and Technology for MANTEC and has been with the company since January 1998. His responsibilities include oversight of the organization’s finances, grants and contracts and the corporate information systems. Scott also delivers information technology planning and consulting services to the manufacturers in the MANTEC region. These services include business process analysis and selection facilitation oriented towards business software, network infrastructure assessment and planning, technology security assessment and planning, implementing broadband strategies, technology strategic planning and technical training.

Before joining MANTEC, Scott spent many of his years working in the manufacturing and distribution industry. Scott holds a degree in Business and Finance and is also CompTIA Network + Certified, Microsoft Certified Professional, Microsoft Certified Engineer and a Microsoft Certified Trainer.



Tom Zbell, *Genedge*

Presentation Title: *Overall Case Studies and Perspectives – Small and Medium-sized Manufacturers in Virginia*

Bio: Tom Zbell is a project manager and lean practice manager at Genedge Alliance. He has demonstrated consulting capabilities in Lean Enterprise Implementation, Office Lean, Lean Six Sigma, Equipment design/Process Engineering, Total Productive Maintenance Systems, Kaizen, Continuous Improvement, and Safety/Environmental Services. Some of his past clients have included the U.S. Navy, U.S. Coast Guard, BAE Systems, Newport News Ship Building, AMF Bowling, Mead Westvaco, Boehringer Ingelheim Chemicals Inc., ABB, Delta Star, Church & Dwight, Lutron, American Red Cross, Sperry Marine, Trex and Wyeth. Mr. Zbell has a MS Organizational Management from Central Connecticut State University, a BS Manufacturing Engineering from Utah State University, and an AS Manufacturing Engineering, Waterbury State Technical College.



Thorsten Wuest, *West Virginia University*

Presentation Title: *Smart Manufacturing for SMM - Opportunities and Challenges*

Bio: Dr. Thorsten Wuest is a faculty member and J. Wayne and Kathy Richards Faculty Fellow in the IMSE Department at WVU and head of WVU’s Smart Manufacturing Lab. He serves as the inaugural IDEA Fellow at Statler College to include principles of innovation, design and entrepreneurship. His academic and professional background reflects his interdisciplinary research and teaching interest with Masters degrees in International Business (New Zealand) and Industrial Engineering and Management as well as a PhD in Production Engineering (Summa Cum Laude), both from the University of Bremen, Germany. He worked as a research scientist for BIBA, Germany (’09-’15) with previous roles incl. German Armed Forces (Lieutenant), Arthur D. Little (Switzerland) and ThyssenKrupp Technologies (Germany). Over the last years, Dr. Wuest successfully acquired several externally funded grants (Industry, DFG, EC, BMBF, etc.) and received several awards for his work, among them multiple best paper awards and an outstanding dissertation award.



Dr. Wuest is a research affiliate of the CIRP, member of IFIP WG 5.1 & 5.7, senior member of IISE as well as in the core team of the World Manufacturing Forum (WMF). He is an associate editor for the International Journal of Manufacturing Research (IJMR) and serves in the editorial board of the Journal of Manufacturing Systems (JMSY). Dr. Wuest published over 80 peer-reviewed articles in international archival journals and conferences and serves as a reviewer for many. Dr. Wuest’s research focus is on smart manufacturing, (closed-loop) product lifecycle management (PLM), data analytics in manufacturing, (I)IoT, product service systems (PSS) and related issues like interoperability between systems and SME specific challenges. In his research, Dr. Wuest aims to create impact for industry and add value for all stakeholders involved.



Mark Walker, D2K Technologies

Presentation Title: *Crafting Intelligent Systems Management Using Requirements-Driven Design*

Bio: Mark Walker received his BSEE from Cal Poly University, Pomona (1990), and his MCompEng from the University of Southern California, Los Angeles, CA (1994), where he specialized in machine intelligence. Prior to his education, he was trained and served as a Nuclear Reactor Operator onboard U.S.S. Long Beach, CGN-9. His experience in artificial intelligence began in 1989 as a DOE undergraduate fellow at the Center for Engineering and Science Advanced Research Lab at Oak Ridge National Laboratory where he developed image processing and perception software for autonomous robots. His work with HUMS and PHM began in 1996 with BFGoodrich Aerospace, Vergennes, VT, where he developed onboard health and state estimation algorithms for the Joint Strike Fighter, and co-authored four patents in applied artificial intelligence. He also spent 6 years as Senior Consulting Engineer for expert system manufacturer Gensym Corporation and 10 years as Lead Engineer, Intelligent Systems for General Atomics (GA), where he led GA in the development of reusable Prognostics and Health Management systems applied to various industries. He founded D2K Technologies in 2014, a solution provider of intelligent model-based reasoning systems for mission critical systems. He also serves as a PHM subject matter expert for NASA, with active projects at SSC and JSC. He resides with his family in Oceanside, California.



Communication & Information Flow to support PHM – Presentations & Panel



Will Sobel, *Vimana*

Presentation Title: *Health and Maintenance Through the Lens of Dynamic Scheduling*

Bio: Mr. Will Sobel is Chief Strategy Officer and Co-Founder of VIMANA, the leading analytics platform for discrete manufacturing, and the Principle Architect and Chair of the Technical Steering Committee for the MTConnect Standard, the leading international semantic standard for manufacturing equipment. In addition, he is also the Co-Chair of the Industrial Artificial Intelligence (AI) Task Group at the Industrial Internet Consortium.

Mr. Sobel brings over 30 years of experience in software architecture and is currently advancing VIMANA, as well as researching standards-based solutions for self-aware Industrial Internet of Things (IIoT) systems in manufacturing. Prior to co-founding System Insights, Mr. Sobel was a visiting lecturer at UC Berkeley and worked for many years developing distributed and SaaS analytics applications financial industry.



Moneer Helu, Systems Integration Division, *NIST*

Presentation Title: *Connecting and Deploying Smart Manufacturing Technology to Support PHM*

Bio: Moneer Helu is the Leader of the Life Cycle Engineering Group in the Systems Integration Division of the Engineering Laboratory at NIST. He co-leads the *Prognostics, Health Management, and Control* project in the Smart Manufacturing Operations Planning and Control program as well as the NIST Smart Manufacturing Systems Test Bed. Dr. Helu’s current research focuses on developing the digital thread to enable and support diagnostics, prognostics, and control for smart manufacturing systems on the shop floor. He has also made contributions in the areas of green manufacturing, process monitoring, and manufacturing data interoperability and management. Dr. Helu is a member of the Technical Steering Committee and Technical Advisory Group for MTConnect, Executive Committee of the ASME Manufacturing Engineering Division, and a Corporate Member of the International Academy for Production Engineering (CIRP).



Joel Neidig, *ITAMCO*

Presentation Title: *Starting Small and Scaling MTConnect Across Multiple Factories*

Bio: Joel Neidig has a bachelor’s degree from Bob Jones University in operations management and has had 13 years of experience integrating manufacturing technology and software development. Neidig sits on the Technical Advisory Group for MTConnect, an open-source, royalty-free standard that is intended to foster greater interoperability between devices and software applications. He has been an active member of MTConnect since 2009. Neidig developed the first iOS and Android-compatible MTConnect apps, and has developed over 65 manufacturing apps for the App Store and Google Play, which have been downloaded over half a million times. Neidig also sits on the Technical Advisory Committee for the Digital Manufacturing and Design Innovation Institute, a federally-funded research and development organization, that encourages factories across America to deploy digital manufacturing and design technologies, so those factories can become



more efficient and cost-competitive. His company was voted the 2014 Autodesk Inventor of the Year by the Autodesk Community. He has been named as a manufacturing “Thought Leader” by IMTS Insider. Neidig recently won second place in the MTConnect Challenge at the 2014 MC2 Conference for his application: “Expanding Manufacturing’s Vision: MTConnect + Google Glass,” sponsored by the National Center for Defense Manufacturing and Machining and the Office of the Secretary of Defense. Since the founding of Manufacturing USA, Neidig and his company have been involved in 4 research projects with DMDII and 2 research projects with America Makes, one of which has transitioned to an additive manufacturing tech startup founded by his company called Atlas 3D and has hired 4 employees as the result of the research they have done with Manufacturing USA. He has previously been the manufacturing keynote speaker at Autodesk University and recently presented at the Automotive Innovation Forum. Neidig was the recipient of SME’s 2015 Outstanding Young Manufacturing Engineer of the Year Award (the award is named in honor of a specific individual who has made lifelong contributions to manufacturing and recognizes exceptional contributions and accomplishments in the manufacturing industry) and was also named one of the 30 Advanced Manufacturing Visionaries by Smart Manufacturing Magazine. He was also the recipient of the 2016 AGMA Next Generation Award which recognizes his contributions and leadership to the members of the American Gear Manufacturers Association and the gear industry. His company was also awarded a Phase I SBIR grant from DARPA for Secure Messaging on the Blockchain Architecture. Recently, Joel spoke at the White House by invitation of the National Economic Council in recognition of the progress that has been made by himself and his company in the Manufacturing USA program. Neidig is very involved in an advisory role at the ITAMCO Manufacturing Education Center located at Plymouth High School, which was started by his company to prepare students for the challenges of careers in manufacturing.



Rob Andes, The Knowledge Design Company

Presentation Title: *Asset Life-Cycle Information Management (ALCIM) Technologies for Prognostic Analysis of CNC Machines*

Bio: Rob Andes is Principal Engineer – Systems Engineering - for The Design Knowledge Company (TDKC) out of Fairborn, OH, located near Wright-Patterson Air Force Base. He is Principal Investigator on multiple R&D efforts, including development of early concepts to fielding of deployed applications for the US Air Force, US Navy and industry. In addition, he is commercialization lead for TDKC high-technology software products. He has a wide range of experience in analysis and design of intelligent user interfaces in complex human-machine domains with focus in development of C3 systems for mission critical support systems utilizing AI for adaptive aiding systems in the space, aviation, and manufacturing domains. As a technology leader and innovator, he has held positions as a key executive and lead team member of R&D efforts and software applications companies, from successful start-up CTO to turn-around specialist at a Fortune 100 company.

Currently, Andes is Principal Investigator on US Air Force sponsored programs for the development of decision aiding applications and condition-based maintenance (CBM) technologies for CNC machine prognostics using analytics and machine-learning techniques.



The Costs and Benefits of Advanced Maintenance in Manufacturing

Doug Thomas, *Applied Economics Office, NIST*

Presentation Title: *The Costs & Benefits of Advanced Maintenance in Manufacturing*

Bio: Douglas S. Thomas is a research economist for the Engineering Laboratory’s Applied Economics Office at NIST. Currently, his activities are focused in two areas of research: 1) manufacturing industry costs and resource consumption and 2) methods for economic decision making in the adoption of technologies and processes in manufacturing. The first area includes measuring and tracking the U.S. manufacturing supply chain using methods such as economic input-output analysis. The second area of research studies barriers to technology and process adoption in manufacturing as well as identifies methods for economic decision making in the adoption of technologies and processes.



Wednesday, May 9, 2018

PLENARY – NIST Smart Manufacturing Programs: Driving Innovation and Reducing Risks of Adoption of New Technologies

Al Wavering, Intelligent Systems Division, NIST



Bio: Albert J. Wavering is Chief of the Intelligent Systems Division (ISD) of the Engineering Laboratory at NIST. ISD develops measurement science solutions for intelligent systems technologies to help its manufacturing industry and government customers drive innovation and enhance their competitiveness and mission effectiveness. Wavering has been at NIST since 1985, serving in a variety of technical and management roles, including mechanical engineer, group leader, program manager, and program analyst in the NIST Director’s Office prior to his current position. He also served for three years as the Acting Deputy Director of the NIST Manufacturing Engineering Laboratory. His research background includes work in robotics and automation, sensing and control, and manufacturing production equipment. He is a Fellow of the Society of Manufacturing Engineers.

Emerging Sensing Technologies to Enable Monitoring, Diagnostics, and Prognostics – Presentations & Panel

Radu Pavel, TechSolve



Presentation Title: *An MTConnect®-based Approach for Machine Health Monitoring*

Bio: Dr. Radu Pavel is Vice President of Engineering and Chief Technology Officer of TechSolve, Inc., a process improvement and machining services organization located in Cincinnati, OH, U.S.A. Dr. Pavel has over 20 years of experience in industry and research laboratories from Europe and United States. He has a Master of Science in Mechanical Engineering, and two PhDs – one in Mechanical Engineering and one in Manufacturing Engineering.

Dr. Pavel’s core expertise includes machining and grinding processes, monitoring of machining equipment and processes, modeling and simulation, test-bed development and instrumentation, data acquisition and analysis, and teaching and training. Dr. Pavel has conducted research and development with Smart Manufacturing technologies for over 12 years. He has been involved with technologies specifically focused on machine health and maintenance since 2007.

Dr. Pavel has published multiple papers in refereed conference proceedings and journals, and organized symposia focused on digital manufacturing, smart machine technologies, and advances in material processing and inspection. He is currently Associate Editor for the Journal of Manufacturing Science and Engineering, and a member of the Executive Committee of Manufacturing Engineering Division of ASME.



Brittany Newell, Purdue University

Presentation Title: *Capacitance Sensors for Industrial Applications*

Bio: Dr. Brittany Newell is an assistant professor at Purdue University in the Purdue Polytechnic Institute School of Engineering Technology. Brittany received her B.S. in Biomedical Engineering from Purdue University and her M.S. and Ph.D. in Agricultural and Biological Engineering from Purdue University. She then worked in industry as a Quality Manager for a contract manufacturing company before joining the Purdue faculty. Brittany completed her Ph.D. in the field of electroactive polymers for industrial applications. Her current research interests are focused on adaptive structures, energy transduction, and methods of manufacturing these materials. She focuses on additive manufacturing techniques for material sensors and actuators and their characterization and production.



Justinian Rosca, Siemens Corporation

Presentation Title: *Validation of the Intelligent Edge*

Bio: Justinian Rosca is Senior Key Expert of Siemens Corp., Corporate Technology in Princeton NJ. He holds Ph.D. and M.Sc. degrees in Computer Science from the University of Rochester and a Dipl. Eng. Degree in Computer and Control Engineering from the Polytechnic University Bucharest. Dr. Rosca is presently an Affiliate Researcher at Princeton University, Electrical Engineering Department and was an Affiliate Professor at the University of Washington, Electrical Engineering Department, from 2008 to 2011. He obtained a certificate in executive management for innovation, from the University of Pennsylvania, Wharton School of Business. Dr. Rosca’s primary research interests span statistical signal processing, machine learning, probabilistic inference, artificial intelligence, sensing and communication, with an emphasis on embedded intelligence in autonomous systems and cyber physical systems. Dr. Rosca holds over 50 patents, 100 publications in the areas of signal processing, machine learning, communications, cyber-physical systems, and co-authored two books in mathematics and signal processing. His scientific contributions were transferred into a variety of products and systems representing embedded intelligence in systems such as microphone array technologies for hearing aids and mobile phones, adaptive multimedia wireless network management, connected and autonomous vehicles, and run-time edge intelligence in industry. These contributions earned him multiple Siemens business unit awards. He served as program chair of the 6th Independent Component Analysis and Blind Signal Separation International Conference, chair of the Neural Information and Processing Systems workshop on Sparse Representations in Signal Processing, and recently as chair of the Data Challenge 2015, 2016 and 2017 competitions of the Prognostics and Health Management (PHM) Society.



Greg Vogl, Intelligent Systems Division, NIST

Presentation Title: *Emerging Sensing Technologies Towards Smart Machine Tools*

Bio: Greg Vogl is a Mechanical Engineer at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland. After working with MEMS as a National Research Council Postdoctoral Researcher, he joined NIST and worked on machine tool metrology and standards development. Currently, Greg is a member of the *Prognostics*,



Health Management, and Control (PHMC) project, which seeks to enable robust real-time diagnostics and prognostics for smart manufacturing systems. Specifically, Greg works on solutions to transform machine tools into smart machine tools.



Ed Spence, Machine Instrumentation

Presentation Title: *Machine Health for the Machine Maker*

Bio: Ed Spence is the Managing Director and Founder of The Machine Instrumentation Group, a collaborative network of CBM product and service providers helping machine OEMs to instrument their own equipment. Prior to that, Ed was the Marketing Manager for the MEMS Sensor Technology Group at Analog Devices, where he defined the accelerometer roadmap for Condition Monitoring.

Planning and Assessment to Promote Monitoring, Diagnostic, and Prognostic Technologies – Presentations & Panel

Karl Reichard, Penn State University Applied Research Lab

Presentation Title: *Driving Requirements For Prognostics - How Far In The Future Do We Need to Predict?*

Bio: Karl M. Reichard, Ph.D., heads the Applied Research Laboratory (ARL) Embedded Hardware/Software Systems and Applications Department. Dr. Reichard has over 25 years of experience in the design and development of advanced measurement, control, and monitoring systems. He received Ph.D., M.S., and B.S. degrees in Electrical Engineering from the Virginia Polytechnic Institute and State University (Virginia Tech). Dr. Reichard is a Research Associate with the Pennsylvania State University ARL, and an Assistant Professor of Acoustics with the Penn State Graduate Program in Acoustics. He leads a group at the ARL focused on the development of embedded sensing and processing hardware and software systems. His own research experience includes the development of embedded and distributed sensing and control systems for robotics, noise cancelation, acoustic surveillance and detection, machinery and system health monitoring, and electro-optics. Dr. Reichard is a member of the Board of Directors of the Prognostics and Health Management Society, the IEEE, and the Acoustical Society of America. He is the author of over 50 papers and articles published in journals and conference proceedings.





Ananth Seshan, MESA International

Presentation Title: *Learnings from Use Cases on Proactive Asset Performance Management*

Bio: Dr. Ananth Seshan is the Chairman of 5G Technologies Ltd., a digital automation solutions group. The group is headquartered in Ottawa and has operations in Mexico and India. He has been the main thought leader behind the successful flagship product of the group, Enterprise Gateway. Enterprise Gateway has a user footprint in 20 countries globally and more than 100 installations in large manufacturing organizations and utilities. The product is the first of its kind in achieving vertical integration between production and the enterprise operations and has served in the field for more than 750,000 hours in major global manufacturing and utility companies.

Ananth has been a consultant to several large manufacturing organizations and utilities worldwide for the last 3 decades in the areas of robotics, automation, and of late, Asset Performance Management and Digital Manufacturing. He was an invited member of a Special Task Force set up by Industry Canada during the turn of the millennium to explore the viability of applying advanced manufacturing technologies as a strategy to build competitive advantage in the manufacturing segment in Canada. He has also served as an invited member of the Steering Committee of a Canadian Federal Center of Excellence in Robotics and Automation. He has been an invited speaker in many international forums on manufacturing automation and has won several awards for innovation and entrepreneurship. He is presently the Chairman of the Asset Performance Management Working Group of MESA, a leading not for profit organization in North America that establishes standards and best practices for the manufacturing industry. Ananth has several publications in journals and international conference proceedings, owns 2 patents, and has authored a chapter in a book published by Springer in 2015 on “Innovative Process Development in the Metallurgical Industry.”

Ananth completed his undergraduate degree in Production Engineering from the Madras University and a Masters Degree in Robotics and Automation from Indian Institute of Technology, Chennai. He received his Ph.D. from the University of Toronto in 1992 in the area of “Common-Sense Reasoning” in Robotic Mechanisms.



Kai Goebel, National Aeronautics and Space Administration (NASA)

Presentation Title: *Designing Resilient Engineered Systems with Prognostics and Health Management*

Bio: Kai Goebel is the Tech Area Lead for Discovery and Systems Health at NASA Ames Research Center which covers the areas of real time monitoring for resilience, safety, diagnostics, and prognostics applied to aeronautics and space systems. Dr. Goebel received a Ph.D. from the University of California at Berkeley in 1996 with a dissertation on monitoring for manufacturing systems. Between 1997 and 2006, he worked at General Electric’s Corporate Research Center in upstate New York where he developed techniques for a number of GE’s industrial applications such as aircraft engines, terrestrial transportation systems, energy applications, and medical systems. He was an adjunct professor at Rensselaer Polytechnic Institute where he taught courses in Applied AI. Dr.



Goebel is now an adjunct professor at Lulea Technical University. He has been co-adviser to a dozen Ph.D. students. He is a co-founder of the Prognostics and Health Management Society and he is currently associate editor of the International Journal of PHM. He holds 18 patents and has published 300 papers in the field. He is member of the SAE Health Management steering committee and the IVHM working group.



Miguel Sáez, *University of Michigan*

Presentation Title: *Modeling and Analysis of Cyber-Physical Manufacturing Systems for Anomaly Detection*

Bio: Miguel Sáez received his Mechanical Engineering degree from La Universidad del Zulia, Venezuela in 2008, the M.Eng in Global Automotive and Manufacturing from the University of Michigan, USA in 2015 and is now working towards the Ph.D. in Mechanical Engineering developing innovative ideas to improve productivity and responsiveness of automated manufacturing systems.

He worked as a Product Engineer at Dana Holding Corporation, Venezuela from 2007 to 2010, leading multidisciplinary design and manufacturing projects, coordinating cost-saving projects using CAD/CAE tools, and testing NVH for vehicle powertrains. He worked as a Senior Manufacturing Engineer at General Motors, Venezuela from 2010 to 2013, developing, testing, and installing semi-automated manufacturing systems, and managing a capital investment project for new vehicle programs.



Jorge Arinez, *General Motors*

Presentation Title: *Towards Systems Integrated Production and Maintenance Operations*

Bio: Dr. Jorge Arinez is a Group Manager in the Manufacturing Systems Research Lab at GM Global Research and Development. His main responsibilities involve strategically defining and managing portfolios of advanced manufacturing systems projects. This also includes leading their development and implementation throughout GM’s global manufacturing operations. Recently, his research is focused on the development of analytical tools for real-time production and process control, maintenance, and asset optimization with a focus on energy efficiency and sustainability of manufacturing systems.



Monitoring and Analysis Technologies for Prognostics and Health Management (PHM) – Presentations & Panel

David Siegel, *Predictronics*

Presentation Title: *Perspectives and Case Studies on PHM Technologies for Manufacturing*

Bio: Dr. David Siegel is currently the Chief Technology Officer for Predictronics Corp. His current role includes developing the technology road map for the company’s predictive monitoring software and service solutions, developing new algorithms and methodologies, as well as leading a data science team to carry out the customization and deployment of various predictive monitoring solutions. Dr. Siegel has led numerous efforts on diagnostic and prognostic software for a variety of industrial customers and applications. A sample of these efforts include advanced diagnostic methods for industrial robots, health monitoring systems for railway applications, failure prediction tools for machine tool bearings, and intelligent maintenance systems for military ground vehicles. Dr. Siegel is also a two-time winner of the Prognostics and Health Management Data Challenge and has won several best paper awards at various conferences focused on predictive monitoring and data analytics.



Nancy Diaz-Elsayed, *University of South Florida*

Presentation Title: *Production Monitoring for Performance and Energy Efficiency Improvements*

Bio: Dr. Nancy Diaz-Elsayed is a Research Assistant Professor at the University of South Florida (USF) in the Department of Civil and Environmental Engineering. She obtained her Ph.D. in Mechanical Engineering from UC Berkeley and prior to working at USF, she was the Sustainable Manufacturing Specialist at Autodesk. Her projects have spanned discrete and continuous processes, including the development of a building intelligence application that combined real-time data with Building Information Models to improve the performance of factories and commercial buildings, and the sustainable design of integrated water and wastewater treatment systems. Her research interests include the modeling of complex systems and processes, technology development for smart and sustainable manufacturing, and the role of industrial symbiosis in the design and growth of urban environments.



Sanket Amberkar, *Falconry*

Presentation Title: *Predictive Analytics Approach with Time Series Data using Machine Learning*

Bio: Sanket leads marketing at Falconry and is responsible for the company’s positioning, thought leadership and go to market strategy. Sanket is the SVP of Marketing at Falconry and has over 20 years of experience in the high tech, energy, industrial and automotive markets in areas ranging from of product development to market strategy. Prior to Falconry, he was VP of Product Marketing for Innovation & New Ventures at Flex, where he brought to market its Innovation services and launched the LabIX startup initiative. Earlier, he led marketing and product development teams at Cisco and Delphi. Sanket holds Master’s degrees in Electrical Engineering and Business Administration – both from the University of Michigan. He is a frequent industry speaker and holds thirteen U.S. patents.





Robert Gao, *Case Western Reserve University*

Presentation Title: *Stochastic Modeling for System Remaining Life Prognosis*

Bio: Robert Gao is the Cady Staley Professor of Engineering and Chair of the Mechanical and Aero-space Engineering department at Case Western Reserve University in Cleveland, Ohio. Since receiving his Ph.D. degree in 1991 from the Technical University of Berlin, Germany, he has been working on multi-physics sensing methodologies, design, modeling, and characterization of measurement systems, multi-resolution signal analysis, and energy-efficient sensor networks for improving the observability of dynamical systems such as manufacturing machines and enhancing manufacturing process and product quality control.

Prof. Gao is a Fellow of the ASME, IEEE, SME, and CIRP (International Academy for Production Engineering), and an elected member of the Connecticut Academy of Science and Engineering. He was a Distinguished Lecturer of the IEEE Instrumentation and Measurement Society and IEEE Electron Devices Society. He served as a Guest Editor for the Special Issue on Data Science-Enhanced Manufacturing of the ASME Journal of Manufacturing Science and Engineering, and was an Associate Editor for the ASME Journal of Dynamical Systems, Measurement, and Control, IEEE Transactions on Instrumentation and Measurement, and IFAC Journal of Mechatronics. He is a recipient of the ASME Blackall Machine Tool and Gage Award, IEEE Instrumentation and Measurement Society’s Technical Award, multiple Best Paper awards, Outstanding Junior and Senior Faculty awards, Outstanding Research Award, and an NSF CAREER award.



ChaBum Lee, *Tennessee Tech University*

Presentation Title: *On-Machine Dimensional Measurement Technology for Prognostics and Health Monitoring for Precision Manufacturing Systems and Processes*

Bio: Dr. Lee is currently an Assistant Professor within the Department of Mechanical Engineering at Tennessee Tech. University where he’s been since 2015. He will be an incoming Assistant Professor in the Department of Mechanical Engineering at Texas A&M University beginning this fall. Prior to his time at Tennessee Tech. he was a Research Assistant Professor (2014-2015) – Department of Mechanical Engineering, University of South Carolina and a Research Associate (2013-2014) – Department of Mechanical Engineering, University of South Carolina. Prior to his university positions, he was a Senior Researcher (2010-2013) at LG Display Co. Ltd. in Paju, Korea. Dr. Lee earned his Ph.D. in 2012 in Mechatronics at Gwangju Institute of Science and Technology (Korea).



Emerging Research Efforts

Junmin Lee, Seoul National University (SNU)

Presentation Title: *Exercising Standardization of Prognostics and Health Management (PHM) for Manufacturing Industry*

Bio: Junmin Lee received the B.S. degree with a double major in Biosystems Engineering and Mechanical Engineering from Seoul National University, Seoul, Republic of Korea, in 2013. He is currently pursuing the Ph.D. degree at the Department of Mechanical and Aerospace Engineering in Seoul National University, Seoul, Republic of Korea. His current research topics include prognostics and health management for electronic products and electric machine drive systems. He was the winner in PHM Society Data Challenge Competition in 2017.



Chan Hee Park, SNU

Presentation Title: *Fault Detection of an OHT (Overhead Hoist Transport) Vehicle Using Feedback Control Signals*

Bio: Chan Hee Park received her B.S. degree from Seoul National University, Seoul, Republic of Korea, in 2016. She is currently pursuing the Ph.D. degree at the Department of Mechanical and Aerospace Engineering in Seoul National University, Seoul, Republic of Korea. Ms. Park's research topics include prognostics and health management (PHM) for electric machines using a data-driven approach. Ms. Park was the winner in PHM Society Data Challenge Competition in 2017 and received the Korean Society of Mechanical Engineers (KSME)-SEMES Innovation Challenge Award in 2017.



Using Unstructured Work Order Data to Improve Maintenance Procedures in Manufacturing

Michael Brundage, Systems Integration Division, NIST

Bio: Michael P. Brundage, Ph.D. is an Industrial Engineer in the Informational Modeling and Testing Group at NIST. Dr. Brundage's interests include Smart Manufacturing Diagnostics for Intelligent Maintenance, Sustainable Manufacturing Performance Measurement, Smart Manufacturing Capability Assessment, and Manufacturing Knowledge Visualization. His work contributes to guidelines for intelligent maintenance and he is part of a task group for creating an ASME Prognostics Health Management (PHM) standards committee. He also worked closely with ASTM International E60.13 in the development of a guideline for sustainable manufacturing performance indicators (ASTM E3096-17). He authored over 25 peer reviewed publications and has chaired multiple ASME MSEC Symposia and industry forums/workshops at NIST. Dr. Brundage is the recipient of the 2018 ASME Old Guard Early Career Award and was selected as one of SME's 2018 Class of 30 Under 30.



NIST Research on Monitoring, Diagnostics, and Prognostics for Manufacturing Workcells

Brian A. Weiss, Intelligent Systems Division, NIST

Bio: Dr. Brian A. Weiss is a mechanical engineer and the project leader of the *Prognostics, Health Management, and Control* (PHMC) project within the Engineering Laboratory (EL) at NIST. His current research efforts are focused on developing the necessary measurement science to verify and validate emerging monitoring, diagnostic, and prognostic technologies and strategies for smart manufacturing to enable manufacturers to respond to planned and un-planned performance changes. The project is focused on the application domains of machine tools and robot systems. From 2013-2016, Dr. Weiss also served as the Associate Program Manager for the *Smart Manufacturing Operations Planning and Control* (SMOPAC) program which contains his PHMC project. Prior to his manufacturing research, he spent 15 years conducting performance assessments across numerous military and first response technologies including autonomous unmanned ground vehicles; tactical applications operating on Android™ devices; advanced soldier sensor technologies; free-form, two-way, speech-to-speech translation devices for tactical use; urban search and rescue robots; and bomb disposal robots. He also spent six years developing robotic crane technologies which included the deployment of a prototype system on a military installation. Dr. Weiss is a current member of the PHM Society Board of Directors and serving on an ASME task group aimed at building up PHM standards and guidelines. His efforts have earned him numerous awards including a Government Computer News (GCN) for IT Excellence Award (2014), Department of Commerce (DOC) Gold Medal (2013), Colleague’s Choice Award (2013), DOC Silver Medal (2011), DOC Bronze Medals (2004 & 2008), and the Jacob Rabinow Applied Research Award (2006). He earned two *Best Paper* and *Best Presentations* awards from the *International Test and Evaluation Association (ITEA)*. He has a B.S. in Mechanical Engineering (2000), Professional Masters in Engineering (2003), and Ph.D. in Mechanical Engineering (2012) from the University of Maryland, College Park, Maryland, USA.



Thursday, May 10, 2018

PLENARY – CCAM Activities in Highly Scalable Computing Systems to Monitor and Analyze Industrial Processes, Diagnose Irregularities, and Automatically Adapt Machine and Process Behaviors

Jaime Camelio, *Commonwealth Center for Advanced Manufacturing and Virginia Tech University*

Bio: Dr. Jaime Camelio is currently the Chief Technology Officer at the Commonwealth Center for Advanced Manufacturing (CCAM) and the Rolls-Royce Commonwealth Professor for Advanced Manufacturing in the Grado Department of Industrial and Systems Engineering at Virginia Tech. Dr. Camelio obtained his B.S. and M.S. in Mechanical Engineering from the Catholic University of Chile in 1994 and 1995, respectively. In 2002, he received his Ph.D. from the University of Michigan.



Standards and Best Practices – Presentations & Panel

Andrew Hess, *Hess PHM Group*

Presentation Title: *PHM – A Key Element Across the Continuum of a Digital Enterprise*

Bio: Andy brings program management, technical, and engineering, logistics, and asset management expertise as a globally recognized leader and expert in the fields of diagnostics and predictive maintenance. For over 35 years, at the Naval Air System Command, Andy led the innovation, development, and implementation of condition monitoring systems for all the Navy fixed wing and helicopter applications. He is widely recognized as a leader in the area of jet engine monitoring systems. Andy helped formulate the autonomic logistics information system concept. Andy is a widely-used consultant to industry, government, and academic organizations in the fields of advanced diagnostics, prognostics, health and asset management, and enterprise-wide applications. Andy is the current president of the PHM Society and remains active in many other professional, advisory, and standards organizations and committees. Andy is also a recent Lifetime Achievement Award recipient from the PHM Society.



Andy started his career in flight testing at the Naval Air Test Center and Naval Air Warfare Center evaluating aircraft systems; developing the first comprehensive engine monitoring system; and playing significant roles in the development of military aircraft. He has been a Senior Engineering Fellow and a Fellow of the Society for Integrated Engineering Asset Management. He led the PHM effort for the Joint Strike Fighter JPO. Through his consulting firm, Andy helped DARPA structure and manage their large Prognosis program. Some of his other clients have included: Bell Helicopter, Boeing, General Atomics, NASA, Honeywell, the US Army CECOM, Sikorsky, Teledyne Controls, the Australian and Canadian governments, the University of Maryland CALCE, and sundry small businesses.



Ravi Rajamani, drR2

Presentation Title: *The Role of Standards in Simplifying the Job of Engineering Complex Products*

Bio: Dr. Ravi Rajamani is an independent consultant who has accumulated years of experience in aerospace propulsion and energy, specifically in data analytics and model-based methods for controls, diagnostics, and prognostics. He has many publications including three books (chief being *Electric Flight Technology: The Unfolding of a New Future*), book chapters, journal and conference papers, and patents. Prior to his current job, Ravi worked at Meggitt, United Technologies Corporation, and the General Electric Company. He has a BTech from IITD, an MS from IISc, a PhD from University of Minnesota, and an MBA from University of Connecticut. He is active within various SAE technical committees dealing with PHM. He is also active in the PHM Society, serving on its board of directors. Ravi is a Visiting Professor of Aerospace, Transport and Manufacturing at Cranfield University. He is the editor-in-chief of the SAE International Aerospace Journal; has been elected a fellow of SAE; and is a recipient of its Forest R. McFarland Award.



Tom Fiske, Yokogawa

Presentation Title: *ISA 108 Intelligent Device Management*

Bio: Dr. Tom Fiske, Principal Technology Strategist, is part of Yokogawa’s Global Strategic Technology Center. He is responsible for establishing the vision of Yokogawa’s Advanced Decision Support solutions that help improve operators’ situational awareness and effectiveness and contributes to Yokogawa’s overall automation strategy. Dr. Fiske has more than 30 years of hands-on experience in research, product development, project management, and process engineering. Throughout his career, he has actively been involved in simulating and optimizing complex production processes. Dr. Fiske has consulted with end-users to address key issues concerning selection, adoption, implementation, and use of manufacturing, automation and control, and production and engineering technology.

Dr. Fiske is an active member in numerous Standards Development Organizations, including ISA, ANSI, and IEC. Dr. Fiske is a graduate of Stevens Institute of Technology with a Ph.D. in Chemical Engineering. He also holds a Master of Science in the Management of Technology from the Sloan School at Massachusetts Institute of Technology (MIT).



Tom Hedberg, Systems Integration Division, NIST

Presentation Title: *Practice and Specification Standards for Design and Manufacturing*

Bio: Thomas Hedberg, Jr. is a Mechanical Engineer in the Systems Integration Division of the Engineering Laboratory at NIST. He is the Project Leader of the *Digital Thread for Smart Manufacturing* project in the NIST *Smart Manufacturing Operations Planning and Control* program and the Co-Leader of the NIST Smart Manufacturing Systems Test Bed. His current research focus is in the areas of digital-product design, smart manufacturing, and lifecycle engineering. Mr. Hedberg is a Voting Member of the American Society of Mechanical Engineers (ASME) Y14.37, Y14.41, and Y14.41.1 subcommittees from the ASME Y14 suite of standards and Co-Chair and Americas Lead for the Visualization Working Group for LOTAR International.



Prior to joining NIST, Mr. Hedberg was a Senior Mechanical Engineer and Technical Lead of the Model Based Enterprise (MBE) group at Honeywell Aerospace. In this role, he developed a strategy and implementation of MBE in Honeywell’s engineering operations. He earned a M.Eng. in Engineering Management with a concentration on Systems Engineering from the Penn State University and a B.S. in Aeronautical and Astronautical Engineering from Purdue University. He is currently a Ph.D. Candidate in Industrial and Systems Engineering at the Virginia Polytechnic Institute and State University. Mr. Hedberg is a licensed Professional Engineer (PE) in the States of Arizona and Maryland.



Logen Johnson, SAE

Presentation Title: *Best Practices in Developing PHM Standards*

Bio: Logen Johnson has been with SAE International for 2 years and is based in Washington, DC. In this role, Logen is responsible for supporting standards development operations for SAE’s aerospace standards program. This includes working with the U.S. and global aerospace community on new standards development as well as global strategy and outreach for SAE.

Prior to joining SAE, Logen worked with other standard organizations in DC. He holds a BS degree from Wentworth Institute of Technology in Electromechanical Engineering.



Donnie Alonzo, ASME

Presentation Title: *ASME Manufacturing Standards Overview*

Bio: Donnie Alonzo earned a Bachelor of Science degree in mechanical engineering from Columbia University in the City of New York. He has since been a Standards and Certification Engineer for the American Society of Mechanical Engineers. Now working with the power and energy related standards committees, he has previously worked with numerous other standards development committees related to manufacturing, and has been helping lead the effort for ASME guidelines in monitoring, diagnostics, and prognostics.

PHM within the International Manufacturing Community – Presentations



Byeng Youn, SNU

Presentation Title: *Frontiers in Korean Manufacturing Prognostics - Success Episodes and Issues*

Bio: Prof. Byeng D. Youn is the Professor of Mechanical and Aerospace Engineering at Seoul National University (SNU) and the CEO of OnePredict Inc. (onepredict.com). Before joining SNU, he was an Assistant Professor in the Department of Mechanical Engineering at the University of Maryland, College Park. He is currently the Future-Tech Consulting Fellow of LG Electronics. He earned the Ph.D. degree from the University of Iowa in 2001. His research goal is to develop rational reliability and design methods based on mathematics, physics, and statistics for use in complex engineered systems, mainly focused on energy systems. His current research includes reliability-based design, prognostics and health management (PHM), energy harvester design, and statistical verification and validation (V&V). His dedication and efforts in research have garnered substantive peer recognition



resulting in notable awards including the ISSMO/Springer Prize for a Young Scientist (2005), the Young Faculty Development Award from the U.S. Nuclear Regulatory Commission (2009), the IEEE PHM Competition Winner (2014), the PHM Society Data Challenge Winners (2014, 2015, 2017), the Shinyang Academic Award (2017), and the ASME IDETC Best Paper Awards (2001, 2008). He has over 300 publications (85 journal articles, over 250 international conference proceedings, and four book chapters) in the area of reliability analysis and design, energy harvesting, and PHM. He also serves as an Editor of many notable journals including Structural and Multidisciplinary Optimization (SMO), International Journal of Precision Engineering and Manufacturing (IJPEM), Journal of Mechanical Science and Technology (JMST), and JMST Advances. His research has been supported by the National Research Foundation (NRF) in Korea, Korea Electric Power Corporation (KEPCO), Samsung Electronics, U.S. Army, Hyundai Motors, LG Electronics, General Motors, and his accumulated funds amounting to 10 million dollars.



Hyunbo Cho, Pohang University of Science and Technology (POSTECH)

Presentation Title: *Data-driven Prognostics for an Assembly Machine for Automatic Transmissions*

Bio: Hyunbo Cho is a professor of Department of Industrial and Management Engineering at POSTECH. He received his BS and MS degrees in Industrial Engineering from Seoul National University in 1986 and 1988, respectively, and his PhD in Industrial Engineering with a specialization in Manufacturing Systems Engineering from Texas A&M University in 1993. His areas of expertise include Smart Manufacturing Systems, Big Data and Predictive Analytics and Cyber-Physical Production Systems.



Hyunseok Oh, Gwangju Institute of Science and Technology (GIST)

Presentation Title: *Korea's Efforts towards PHM in Semiconductor and Automotive Manufacturing*

Bio: Hyunseok Oh is an Assistant Professor with the School of the Mechanical Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju, South Korea. His research interests include prognostics and health management and model verification and validation. Dr. Oh received the A. James Clark Fellowship (2007) and several awards including the IEEE PHM Data Challenge Competition Winner (2012), the PHM Society Data Challenge Competition Winner (2014, 2015), and the ACSMO Young Scientist Award (2016).

He received the B.S. degree in mechanical engineering from Korea University, Seoul, South Korea, in 2004, the M.S. degree in mechanical engineering from Korea Advanced Institute of Science and Technology, Daejeon, South Korea, in 2006, and the Ph.D. degree in mechanical engineering from the University of Maryland, College Park, MD, USA, in 2012.



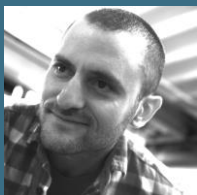
Visualization Tools for PHM – Presentations & Panel



Jeremy Marvel, *Intelligent Systems Division, NIST*

Presentation Title: *Visualization Tools for PHM: Metrics of Effective HMI*

Bio: Jeremy A. Marvel is a research scientist and project leader at NIST. Dr. Marvel joined the Intelligent Systems Division at NIST in 2012, and has over thirteen years of robotics research experience in both industry and government. His research interests include intelligent and adaptive solutions for robot applications, with particular attention paid to human-robot and robot-robot collaborations, multirobot coordination, industrial robot safety, machine learning, perception, and automated parameter optimization. Dr. Marvel currently leads a team of scientists and engineers in metrology efforts at NIST toward collaborative robot performance, and developing tools to enable small and medium-sized enterprises to effectively deploy robot solutions.



Sinan Bank, *Siemens Corporation*

Presentation Title: *The Use of Digital Twin and Mixed Reality for Monitoring, Diagnostics, and Prognostics*

Bio: Hasan Sinan Bank is a research scientist in Product Runtime Systems at SCCT, Princeton NJ. He has a track record of delivering high technology and intelligent solutions in Siemens and government projects including the project - Siemens Agile Manufacturing System (a.k.a. SpiderBots). He has more than 5 years of experience in software integration of mechatronics, control, optimization, and autonomous systems specifically with the focus of advanced manufacturing such as machining and laser-based additive manufacturing. He has earned recognition and contributed in the multi-criteria toolpath optimization of machining processes. He has 10+ scientific publications and several patents in his domain of expertise including MxR implementations for manufacturing and control purpose.



Demystifying Today’s AI

Michael Garris, *Information Technology Laboratory, NIST*

Bio: Michael Garris is a senior scientist and founding chair of the Artificial Intelligence (AI) Community of Interest at NIST where he has worked for the past 31 years with a technical focus in the areas of AI, image processing, pattern recognition, and biometrics. Mr. Garris serves on behalf of the Department of Commerce as co-chair for the President’s National Science and Technology Council’s (NSTC) Subcommittee on Machine Learning and Artificial Intelligence (ML/AI), and he served as member of the NSTC Networking and Information Technology Research and Development (NITRD) Subcommittee’s AI Task Force. For 7 years in his career, Mr. Garris was privileged to manage the world-class biometric research, standards, test, and evaluation Image Group in NIST’s Information Technology Laboratory (ITL). In 2003, Mr. Garris was part of a biometrics team which received the Department of Commerce Gold Medal Award. He has a BS in Computer Science from Clarion University of Pennsylvania, and a MS in Computer Science from Johns Hopkins.



Industry AI -- A System Perspective in Machine Learning for Smart Manufacturing and Maintenance

Jay Lee, *University of Cincinnati, Center for Intelligent Maintenance Systems*

Bio: Professor Jay Lee is Ohio Eminent Scholar, L.W. Scott Alter Chair Professor, and Distinguished University Research Professor at the University of Cincinnati and is founding director of National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC) on Intelligent Maintenance Systems (www.imscenter.net) which is a multi-campus NSF Industry/University Cooperative Research Center which consists of the University of Cincinnati (lead institution), the University of Michigan, Missouri University of S&T, and the University of Texas-Austin. Since its inception in 2001, IMS Center has so far conducted more than 100 projects and has been supported by over 100 companies and research institutions worldwide including P&G, GE Aviation, Boeing, Toyota, Nissan, Goodyear, Harley Davidson, Caterpillar, Siemens, Intel, Samsung, Bosch, National Instruments, Siemens, Chevron and many more. The cumulative benefit of IMS technologies was estimated to be \$1.4 Billion by 2015.

His current research focuses on predictive big data analytics and cyber physical systems, prognostics and health management (PHM), and Industry 4.0 systems. He was selected to be one of the 30 Visionaries in Smart Manufacturing in U.S. by SME in Jan. 2016. In addition, he is co-Founder of Predictronics--a start-up company from NSF IMS Center of the Univ. of Cincinnati through NSF ICorp award in 2012 as well as a co-Founder of CyberInsight Technology in 2016.

Planning for the Future – Building and Leveraging Artificial Intelligence – Panel Discussion

Michael Garris, *Information Technology Laboratory, NIST*

Jay Lee, *University of Cincinnati, Center for Intelligent Maintenance Systems*