Assigned Session Code: SA5

Author(s): Adam Jablonski, Kajetan Dziedziech, Tomasz Barszcz

Organization: AGH University of Science and Technology

Paper Title: Signal processing considerations for low-powered embedded systems

Date / Time of Session Presentation: 5/16/2017 2:00:00 PM

Abstract:

A general inclination towards cheaper condition monitoring recently compelled designers and manufacturers of condition monitoring systems (CMS) to shift towards simpler, more autonomous, and affordable solutions. Likewise, cost-cutting policies of large companies made it more difficult to conduct large-scale CMS investments without initially proved positive financial outcome. Therefore, industrial players are currently more interested in cheaper, simpler solutions and the cost of limited functionality and user interface features. In consequence, regardless continuous development of more advanced electronic boards, competitive CMS manufacturers are encouraged to take advantage of commonly available, low-cost data processing units at the price of limited computational capabilities. The additional benefit of this approach is lower power consumption comparing to latest CPU boards, which sometimes is a crucial factor in industrial applications.

The paper shows selected, recently patent-filed signal processing paths allowing calculation of standard time domain and frequency domain, both, wideband and narrowband machine health indicators on CPU boards with limited computational power. In particular, the paper illustrates how to optimize calculations of different estimators when raw data is highly sampled (40 kHz), while FFT buffer accepts no more than 2048 samples. The considerations cover calculations of both, fixed-time synchronous signals and phase-marker triggered, asynchronous data as well as both, time-domain estimators and frequency-domain estimators. Additionally, the paper shows a novel concept of dynamic selection of optimal calculation path of predefined estimators with respect to fluctuating operational speed. As illustrated in the paper, final values of diagnostic indicators typically differ insignificantly from high-class reference, stationary condition monitoring systems, while benefiting from much more attractive price and significantly lower power consumption.

Assigned Session Code: SA3

Author: Kajetan Dziedziech, Adam Jablonski

Organization: AGH University of Science and Technology

Paper Title: Novel simple tool for extraction of components in time-frequency domain: Exemplary Applications

Date / Time of Session Presentation: 5/16/2017 11:30:00 AM

Abstract:

Many of the engineering structures operate under non-stationary conditions resulting in time-varying frequency components. Analysis of such in time or frequency domain may be difficult or even impossible due to different phenomena involved. Typically implemented solution to this problem is the angle and order domain analysis. Recalculation from time to angle domain requires e.g. speed signal to be recorded next to vibration one. However, in some scenarios, acquisition of speed signal may be not available, due to practical limitations. If the speed fluctuations are limited, or recorded vibrational signal is free from the environmental and measurement disturbances, it is possible to extract the speed signal from raw time waveforms. State-of-the-art methods include e.g. semi-automatic tracking of the ridges of the Short-Time Fourier Transform for speed signal reconstruction. However, these methods can fail if the time-varying frequency components cross with each other. Moreover, it is very common that complicated structures operating in non-stationary conditions are controlled by sophisticated electronic systems, which can introduce constant frequency noise to the measuring equipment. This can lead to the interference of these time-invariant and time-variant frequency components. This paper presents simple and easy way to use tool for hand selection and tracking of the desired components, thus making complex time-frequency filtration easy. Inverse Short-Time Fourier Transform is used for reconstruction of time signal for given time-varying frequency component. Finally, instantaneous phase and frequency is be calculated via Hilbert Transformation to extract the speed signal. The presented method shows how a particular tool developed within 3-dimensional image processing branch could be implemented in analysis of 2-dimensional signals characterized by time-frequency varying components.

Assigned Session Code: S11

Author(s): Wojciech Staszewski , Adam Jablonski, Tomasz Barszcz

Organization: AGH University of Science and Technology

Paper Title: Novel Micro, Wireless, MEMS-based CMS for Modern Machine Tools with Limited Access

Date / Time of Session Presentation: 5/18/2017 11:00:00 AM

Abstract:

Currently available condition monitoring systems (CMS) offer many types of tools, including stationary systems, portable on-site instrumentation and finally wireless, autonomous systems. However, for a particular group of modern machine tools with limited access, like lathes, milling or grinding machines, none of this tools could be used due to limited access, space constraints and cabling restrictions. Firstly, stationary CMS use wires connecting vibration sensors with data acquisition unit (DAQ), which are prohibited by both, safety and topological reasons because of sealed door. Secondly, portable systems could not be used, because modern mining machinery is entirely closed, and an a diagnostic engineer is not allowed to be present inside the machine housing while operating. Moreover, some of machines perform open lubrication, which makes supervised monitoring impossible due to constant lubricant splashes. Tertiary, currently available leading wireless sensors are characterized by relatively significant size, ca. 1,5 by 4 inch., and close to 10 oz. weight; therefore, introducing significant volume and mass to the machine spindle. Moreover, the rapid characteristics of the spindle movement would generate a significant inertia to the sensor causing extra vibrations and possible detriment to sensor mounting. For these reasons, modern machine tools are generally not equipped with external CMS systems.

Recently developed MEMS technology made it possible to design a novel, small-size unit, which is capable to work autonomously in environments with limited accessibility, where volume and weight matter. In contrast to commonly used piezoelectric accelerometers, MEMS vibration sensors need much less operational power, which is a major concern in wireless designs. Moreover, latest MEMS sensors are characterized by comparable frequency response to accelerometers. The short range wireless communication can be applied to avoid connecting cabling. The paper shows a prototype of a micro-size unit for data acquisition, data processing, data storage, and transfer. The prototype is evaluated on industrial lathe.

Assigned Session Code: SA9

Author(s): Adam Jablonski, Kajetan Dziedziech, Tomasz Barszcz, Fakher Chaari, Oussama Graja

Organization: AGH University of Science and Technology

Paper Title: Gearbox Fault Detection by Sensor Fusion

Date / Time of Session Presentation: 5/16/2017 4:30:00 PM

Abstract:

For many decades, a number of gearbox fault detection methods have been proposed by scientific and industrial researches. These methods include, for instance, classical time synchronous averaging (TSA), spectral interpretation of gear meshing frequencies (GMF) together with corresponding sidebands, signal resampling followed by order analysis, and envelope analysis. More recent developments include e.g. sideband energy ratio (SER) or instantaneous circular pitch cyclic power (ICPCP). However, in all considered cases, a particular method used data from a one type of sensor, namely piezoelectric accelerometer. Research of recently available alternative sensors, including DC accelerometers and piezoelectric strain sensors show that different frequency characteristics of different types of sensors significantly influence the capability of gearbox fault detection, because different types of faults manifest themselves in different frequency ranges.

As shown by the research, a fusion of data collected with sensors with different frequency characteristics enables more effective ultimate condition monitoring of gearboxes comparing to monitoring based on a single type of sensor. From industrial point of view, the application of recent, alternative sensors is especially attractive to assessment of technical condition of low-speed gearbox drive trains, for which standard, piezoelectric accelerometers have not proved to be sufficiently effective. The paper shows examples of capabilities of fault detection with different sensors for standard gearboxes as well as ultra-low speed gearboxes. The application of investigated sensors is compared along with additional modal analysis giving additional insight to the results.

Assigned Session Code: DA5

Author(s): Tomasz Barszcz, Adam Jablonski

Organization: AGH University of Science and Technology

Paper Title: Novel Technology for Visualization of Long-term Data Enhancing Condition Monitoring Systems: Case Studies

Date / Time of Session Presentation: 5/16/2017 2:00:00 PM

Abstract:

A typical condition monitoring systems is capable of displaying time series in two formats, namely as single or multiple series of diagnostic health indicators, commonly known as *trend graphs* as well as single raw, time waveforms, commonly known as *time graphs*. Trend graphs constitute a fundamental tool for monitoring of machine health by visualization of time-based indicators and spectral narrowband indicators. On the other hand, raw time waveforms are used as a starting point for advanced signal analysis. However, due to limited computational and visualization capabilities, currently available commercial CMS systems (following proper norms) offer registration, processing and visualization of 1s-100s signals. In case of analysis of continuous, long-term data (i.e. few days), data analysis calls for unsupervised technics, e.g. data mining. Likewise, analysis of long-term trend series, e.g. 1-s analyses exceeding 3x10e7 samples per year, calls for ANN or pattern recognition methods. However, many conclusions concerning the analyzed data could be drawn by unconstrained visualization of large-size data.

Recently developed technology based on hybrid design combining high performance real-time graphic charts and statistical data description, virtually enables visualization of unlimited number of both types of time series. In case of raw time signals, novel technology enables at-a-glance assessment of a content large sets of data from multiple channels, which leads to rapid selection of most desired fragments of raw data for analysis. In case of trend graphs, novel tool enables simultaneous visualization of unlimited number of time series with unlimited number of points. The true novelty of the developed technology lies in its dynamic behavior, in contrast to statically calculated approximations known for many years for SCADA manufacturers.

The paper shows how the novel technology enhances diagnostic analysis of different machinery by means of rapid, unlimited visualization of raw time series and multiple, large trend graphs. Several case studies show possible combinations of novel data display, including analysis of highly fluctuating wind turbine data, non-stationary automotive data, multi-process channels data and machine tool troubleshooting data.

Assigned Session Code: HP3

Author: James Christensen, Ph.D.

Co-Author(s):

Organization: Air Force

Paper Title: Confined Space Monitoring System

Date / Time of Session Presentation: 5/17/2017 11:30:00 AM

Abstract:

The confined space monitoring system is a research and development effort being conducted by the Air Force Research Laboratory in partnership with the Air Force Sustainment Center. The project goals are to develop, test, and demonstrate a wearable monitoring system for maintainers who must routinely enter confined spaces such as aircraft wing fuel tanks, landing gear pods, and dry bays. Currently, confined space maintenance requires a worker to function as a dedicated confined space attendant who is dedicated to visually and verbally verify the safety of the persons working inside. This requires constant line-of-sight and at Warner Robins Air Logistics Center alone requires approximately 40,000 hours of labor per year. The wearable monitoring system will track location, health status, and provide communications functionality in order to enhance safety while reducing the labor burden of providing confined space attendants. The project team includes AFRL (RX, RY, and 711th), AFSC, Warner-Robins ALC, Aptima, and Lockheed Martin. Key challenges from a monitoring perspective include noisy/unreliable sensor data, individual differences (from one person to another), and data fusion/reduction to support effective decision making. This presentation will provide an overview of the project, current challenges, and proposed solutions.

Assigned Session Code: FA8

Author: Debbie Aliya

Co-Author(s):

Organization: Aliya Analytical, Inc.

Paper Title: The Flint Water Crisis: Timeline of Events, Evaluation of Technical and Human Factors, Why it Matter

Date / Time of Session Presentation: 5/16/2017 4:00:00 PM

Abstract:

The lead contamination of the Flint, Michigan drinking water supply had its roots in the economic downturn. The state appointed financial manager had no obligation to consider scientific facts related to enforcement of the Federal Safe Drinking Water Act. The low income residents of Flint (most of them) were served, in some cases, with water that had so much lead it fell within the Federal range for hazardous waste. The physical root cause of the lead contamination was the refusal of the financial manager to approve the $137.00 daily cost of the corrosion prevention chemical when he cut the city off of the purchased water they had been buying for decades from a neighboring city, and forced them to pump water from the Flint River. Potential effects on the duration and severity of the crisis, including the low ranking science education in the USA, and the troubles in the traditional media, will be explored.

Assigned Session Code: T2

Author: Debbie Aliya

Co-Author(s):

Organization: Aliya Analytical, Inc.

Paper Title: Training: Critical & Creative Thinking for Effective Decision Making

Date / Time of Session Presentation: 5/15/2017 8:30:00 AM

Abstract:

This one-day seminar will help attendees to get to a different level of thinking in order to find effective strategies to overcome the limitations of our current difficulties

Assigned Session Code: DA6

Author: Preston Johnson

Co-Author(s):

Organization: Allied Reliability Group, Inc.

Paper Title: Life in the Flow of Data from Inspection to Analytics to Business Decisions

Date / Time of Session Presentation: 5/16/2017 2:30:00 PM

Abstract:

Each machinery inspection data set has its own characteristics, its own ability to detect defects in our equipment, and its own data formats. Unifying these data items into a collaborative system is a multi-step process, yielding a transformative life of data and resulting information. This presentation describes the data types, initial meta data, and equipment conditioning indicating features. From this point, condition indicating features combine in new forms to provide a holistic view of equipment health when combined with domain knowledge. The presentation describes the fusion of inspection data sources with encapsulated domain knowledge that facilitates rapid assessments of machine health.

Assigned Session Code: K2

Author: John Schultz

Co-Author(s):

Organization: Allied Reliability, Inc.

Paper Title: Keynote: IIoT: Two Decades of Application and the Future Capitalization of Innovation Rewards

Date / Time of Session Presentation: 5/16/2017 9:15:00 AM

Abstract:

Assigned Session Code: T4

Author: Preston Johnson

Co-Author(s):

Organization: Allied Reliability, Inc.

Paper Title: Training: An Introduction to Reliability Engineering Fundamentals

Date / Time of Session Presentation: 5/15/2017 8:30:00 AM

Abstract:

This short half day tutorial, introduces several key topics in reliability engineering. The tutorial begins with and introduction to the Failure Reporting Analysis and Corrective Action (FRACAS) model, and the related Proactive Workflow Model. The tutorial then moves into understanding the machinery within the operational facility, its components, failure modes, and criticality. The tutorial then introduces reliability centered maintenance, root cause analysis, and condition based maintenance. The tutorial concludes with an introduction to preventative maintenance, work procedures, and asset health assurance. After attending the tutorial, the attendee will recognize where each topic plays in running a reliable facility, using a proactive workflow model.

Assigned Session Code: PHM3

Author: Le Le Qi

Co-Author(s):

Organization: Beihang University

Paper Title: Research of Reliable Life Assessment for Cemented Carbide Cutting Tool

Date / Time of Session Presentation: 5/17/2017 11:30:00 AM

Abstract:

Based on the failure mechanism of cemented carbide cutting tool, a tool wear life prediction model was built, and then proposed a calculation method of tool's life by considering the cutting test data for model fitting and the influence of random factors in life prediction. According to the distribution regularity of tool's life, the dispersion coefficient method was used in the calculation of tool's safety life, which was commonly used in fatigue life prediction. Conduct research in fatigue breakage occurred during the machining by using the finite element simulation method. Based on stress change in cutting process and fatigue performance test results, use stress strength interference model to evaluate the reliability of the tool.

Assigned Session Code: CBM3

Author: Chaojie Qi

Co-Author(s): Yufeng Sun Yaqiu Li

Organization: BeiHang University

Paper Title: A failure polymorphism theory for system reliability modeling considering failure mechanisms correla

Date / Time of Session Presentation: 5/16/2017 11:30:00 AM

Abstract:

Failure mechanism is the root cause of product failure and reflects the relationship between internal variables and product life. Most researches follow the independent event competition assumption which ignore the dependence between different failure mechanisms, even failure dependence has been extensively treated in reliability modeling for complex systems.Engineering practices indicates that all failure scenarios of complicated systems could be finally traced back to several dependent failure mechanisms of certain units. The interactions among different units' failure modes generated by their functional or structural dependences are supposed as the failure polytheism.

Assigned Session Code: DA3

Author: Fangfang Shao

Co-Author(s): Yaqiu Li, Yufeng Sun

Organization: Beihang University

Paper Title: Reliability Modeling of Complex Multi - State System Based on Bayesian networks

Date / Time of Session Presentation: 5/16/2017 11:30:00 AM

Abstract:

In this paper, a new method for reliability modeling of complex multi-state systems based on BN is proposed based on the uncertainty reasoning and graphical representation of Bayesian networks (BN).

Assigned Session Code: DIA8

Author: Ido Dadon

Co-Author(s):

Organization: Ben-Gurion University

Paper Title: Clearance Influence on Vibrations of Gear Systems

Date / Time of Session Presentation: 5/18/2017 9:00:00 AM

Abstract:

Discontinuity contact in gear transmissions derives particularly from presence of clearance between meshing teeth. The gap between the width of a tooth space (the space between two subsequent teeth) and the thickness of the engaging tooth is called backlash and it is measured on the pitch circles. The main purpose of backlash is to prevent gears from jamming by making contact on both sides of their teeth simultaneously. Also, the presence of backlash is required to allow for lubricant space and thermal expansion. This clearance can be produced by reduction of the tooth thickness below the ideal thickness. Another way to alter the amount of backlash is by modifying the distance between the gear wheels' centers. The amount of backlash is affected by manufacturing and assembling errors. The main goal of this research is to develop an algorithm for detection of backlash based on vibration signatures. This paper presents an evolution of an existing dynamic model of gears. In this study, the modeling principles of backlash in the interaction between a gear pair are presented. An experimental test will be presented in order to validate the simulation analysis results.

Assigned Session Code: FA6

Author: Guru Pandian

Co-Author(s):

Organization: Center for Advanced Life Cycle Engineering

Paper Title: Assessing the Long-term Reliability of Electronic Assemblies Under Laboratory Storage and Usage Cond

Date / Time of Session Presentation: 5/16/2017 2:30:00 PM

Abstract:

Ever since the prospect of the European Union's Restriction on Hazardous Substances (RoHS) Directive began in the late 1990s, industry and academia have researched and tested several materials that can be substituted for lead-based solder. The goal was to find solders that are comparable to or more reliable than tin-lead solders. After numerous experiments, SAC305 (tin-96.5%, silver-3%, copper-0.5%) solders were determined to be comparable to tin-lead solders under accelerated temperature cycling and vibration loads. This study used nine lead-free (SAC305) computers manufactured from 2005 to 2007. This study provides never before produced data on the reliability of lead-free electronic assemblies under real-time operating and storage conditions.

Assigned Session Code: FA4

Author: Guru Pandian

Co-Author(s):

Organization: Center for Advanced Life Cycle Engineering

Paper Title: Analysis of Reliability Risks in Transitioning to Lead-free Electronics

Date / Time of Session Presentation: 5/16/2017 1:30:00 PM

Abstract:

The European Union's Restriction on Hazardous Substances (RoHS) Directive, imposed on electronics manufacturers in 2006, banned the use of certain toxic substances such as lead and cadmium in components and assemblies. Simulation was conducted using CalcePWA software to compare the reliability between tin-lead and SAC305 solder under temperature cycling and vibration loading in addition to assessing the risk due to tin whiskers. Concerns about the changes in manufacturing practices, effects of storage and handling conditions on manufacturing defects, susceptibility to electro-chemical migration, and corrosion of solder and surface finishes were addressed through FMMEA. The study provides assessment and important factors to be considered and monitored during lead-free transition.

Assigned Session Code: DIA4

Author: Rushit Shah

Co-Author(s):

Organization: Center for Advanced Life Cycle Engineering (CALCE), University of Maryland, College PArk

Paper Title: Fault Detection in Bearings Using Autocorrelation

Date / Time of Session Presentation: 5/17/2017 3:30:00 PM

Abstract:

Autocorrelation has been historically used for denoising data. Autocorrelation is a special case of cross-correlation wherein a signal is correlated with a time-lagged version of itself – the resulting signal comprises only the periodic information from the original signal whilst eliminating noise. This property of autocorrelation can be particularly useful in analyzing bearing faults since vibration data from a bearing, with local faults/defects, consists of cyclostationary acceleration signals usually contaminated with noise from sensors and other environmental factors. This study introduces a method which provides early failure warning in rolling element bearings by applying an autocorrelation operation to vibration data. The Sequential Probability Ratio Test (SPRT) is used to detect anomalies indicative of incipient failure. The results from the autocorrelation analysis are compared with results from a simple moving-RMS analysis of the acceleration data. The proposed method based on autocorrelation is shown to provide an earlier warning of failure than the RMS-based method. This method can detect early stages of degradation in bearings – which in turn can allow earlier scheduling of maintenance and the avoidance of system failures.

Assigned Session Code: K1

Author: Dr. Richard Greaves

Co-Author(s):

Organization: Chief of Technology Officer Emeritus, Meggitt PLC

Paper Title: Keynote: An Aerospace Perspective on MFPT; learning from the Past to shape the Future

Date / Time of Session Presentation: 5/16/2017 8:45:00 AM

Abstract:

Assigned Session Code: DIA9

Author: Yimin Shao

Co-Author(s): Pan Sun, Fang Guo and Jing Liu, Liming Wang

Organization: Chongqing University

Paper Title: Local Fault Diagnosis of Non-Stationary Gearbox Based on Order Envelope Analysis

Date / Time of Session Presentation: 5/18/2017 9:30:00 AM

Abstract:

Tooth root crack is a common fault in gear system, it's of significant to detect the crack fault during the operation process of the gearbox. However, the gearbox usually working in a non-stationary condition, namely speed or load are time varying, which increases the difficulty of fault diagnosis since the statistic features and spectrum vary by time. In this paper, based on order spectrum a fault diagnosis approach is developed for non-stationary vibration signals. Firstly, an accelerometer and an encoder are mounted on the gearbox to acquire non-stationary vibration data and rotating speed, respectively. After that, the angle domain signals are derived from the non-stationary vibration data by interpolation algorithm. To eliminate the negative effect caused by the non-stationary signal under speed fluctuation, the crest factor of order cepstrum is proposed as a feature parameter to monitor the health condition of gearbox. Finally, the proposed approach is assessed by seeded tooth root crack faults of different severity, results show that the new approach can effectively detect both light-severity and heavy-severity tooth cracks.

Assigned Session Code: SYST2

Author: Victor Rosa

Co-Author(s):

Organization: Cleveland State University

Paper Title: The Advanced Noise Control Fan and the Systems Engineering Method

Date / Time of Session Presentation: 5/18/2017 9:00:00 AM

Abstract:

The NASA Glenn Research Center's Advanced Noise Control Fan (ANCF) started its research in the early 1990s at the Aero-Acoustic Propulsion Laboratory (AAPL). The ANCF was used to support noise reduction in engine fan components. ANCF was developed to identify successful concepts for engine fan acoustic testing. These concepts were then implemented into high speed fan designs that were tested at the 9x15 WT, which incurs a significantly higher cost. In this way, the ANCF has substantially contributed to the advancement of the understanding of the physics of fan tonal noise generation. Due to the technological advancements of high speed fan designs over the last several decades, there became a critical need for a new Fan Test Rig that would enable successful completion of the NASA/Industry noise reduction program goals. To make room for this new capability, it was decided that the ANCF would be loaned to the Notre Dame University institution to support continued testing for interested companies and also to provide educational opportunities. This presentation will discuss how a Systems Engineering method was used to document and detail the dismantling, shipping and reassembly of the components of the ANCF into its new location.

Assigned Session Code: TU5

Author: Thomas Walter

Co-Author(s):

Organization: Consultant

Paper Title: Tutorial: Rotor Dynamics For Vibration Analysts

Date / Time of Session Presentation: 5/18/2017 10:30:00 AM

Abstract:

OVERVIEW: In keeping with the conference theme, this presentation will begin with a review of how machinery rotor dynamics has developed over the years. It will then focus on how rotor dynamics can be effectively used to assess machinery condition and diagnose problems.TARGET AUDIENCE: Those most likely to be making and interpreting vibration measurements - machinery users and maintainersSCOPE: Describe ways to estimate approx. critical speeds, and cipher them from resonances & other vibration phenomena. Describe how this can differ depending on the sensor and signal conditioner used. Explain the influence of various bearing types on a rotor's synchronous and non-synchronous dynamics. Describe how a machine's installation (foundation, mounting, external loads, etc.) can affect it's dynamics.VISUAL AIDES:A small rotor kit will be available, with eddy current probes, and some instrumentation to demonstrate several of the items discussed.

Assigned Session Code: S7

Author: Shan Guan

Co-Author(s): Knut Erik Knutsen Øystein Åsheim Alnes

Organization: DNV GL

Paper Title: Condition Monitoring based on FMECA: A Case Study of Sensors Specifications for Maritime

Date / Time of Session Presentation: 5/18/2017 8:30:00 AM

Abstract:

For Maritime, one technical challenge associated with ship machinery condition monitoring is to select the best suitable sensors technology as ship owners always desires an economically viable, maintenance-free while technically reliable monitoring system. In this case study, condition monitoring of a tunnel thruster based on Failure Mode, Effects and Criticality Analysis (FMECA) was chosen to demonstrate the basic approach to overcome this challenge. Based on potential failure modes, four types.

Assigned Session Code: S9

Author: Shan Guan

Co-Author(s): Christopher Taylor Narasi Sridhar

Organization: DNV GL

Paper Title: Prediction of Sensor System Reliability

Date / Time of Session Presentation: 5/18/2017 9:30:00 AM

Abstract:

This paper summarized influencing factors to the sensor system reliability used in Oil and Gas. A management plan based on criticalities of influencing factors to the overall system is proposed. Prediction of sensor system reliability will be especially useful in the situation where sensor systems can degrade over time in service. A modeling approach has been carried out in this paper to combine the Bayesian network modeling and "Analytical Redundancy relations" Methodology.

Assigned Session Code: CBM2

Author: Ankit Patel

Co-Author(s):

Organization: Drexel University

Paper Title: Autonomous Vehicles: Component Failure Analysis

Date / Time of Session Presentation: 5/16/2017 11:00:00 AM

Abstract:

This presentation is centered on the premise the Intelligent Transportation Systems (ITS), the automobile and the environment in which it operates will require the automobile to have an on-board Health and Usage Monitoring Systems (HUMS) to operate safely on roadways. HUMS are in their early stages of use to monitor vehicle components and critical structures to prevent routine and catastrophic failures. Vehicle health monitoring, prognostics, diagnostics and condition-based maintenance are the central tenants of a proposed HUMS for autonomous automobiles. Over the past decade, autonomous vehicles have been studied and developed for a real world application. It is essential to understand the critical assets that need to be monitored in those systems to conduct safe operations in ITS. This paper identifies the components that maybe required monitored and some methods that would be employed to monitor those components.

Assigned Session Code: S10

Author: David Change

Co-Author(s):

Organization: Dytran Instruments, Inc.

Paper Title: Introducing CAN-MDTM: Bus-based Digital Smart Accelerometers

Date / Time of Session Presentation: 5/18/2017 10:30:00 AM

Abstract:

The innovative (patent pending) CAN-MDTM (Controller Area Network – Machinery Diagnostic) platform integrates a bus-based, digital smart accelerometer network with configurable software for machinery health monitoring and diagnostics. In addition to the accelerometers the CAN-MD™ network also accommodates accessories such as Rotor Track Sensor integration and Speed/Azimuth Tachometers. CAN-MD™ reduces installed weight, simplifies wiring runs, and reduces the complexity of the "Vibration Health" portion of Health and Usage Monitoring Systems (HUMS) on rotorcraft. Additionally, this technology platform can be applied to most any rotating machinery including fixed-wing aircraft, industrial off road machinery and petrochemical plant process machines. Bus-based digital sensors eliminate the need for individual cables from each analog sensor to a central box. CAN-MD™ spreads the digital signal processing (DSP) over the entire network. Raw accelerometer, tach and tracker data is processed within each sensor and results are reported over a single wire as Condition Indicators (CI's) via CAN bus. The analysis software on board each sensor is user-configurable so it can be optimized for any rotating machinery application. Looking ahead, CAN-MD™ is ideal for autonomous vehicle monitoring where no operator is present to identify impending mechanical issues that could affect vehicle safety or operation.

Assigned Session Code: TU4

Author: Don Thompson

Co-Author(s):

Organization: GBS Group

Paper Title: Strain Gage Technology and Main Propulsion Alignment on US Navy Assets

Date / Time of Session Presentation: 5/16/2017 3:30:00 PM

Abstract:

Tutorial

Assigned Session Code: CBM1

Author: Tapan Shah

Co-Author(s):

Organization: GE Global Research

Paper Title: An Analytical Approach to Monitor Main Bearing Health

Date / Time of Session Presentation: 5/16/2017 10:30:00 AM

Abstract:

The dual role of main bearings in locomotive engines is to provide support to the crankshaft and reduce friction between the crankshaft and the stationary parts. Any failure of the main bearing can damage the entire engine leading to material, logistical and reputation costs. Because of the increased heat, pressure and metal-to-metal contact, the connecting rod and crankshaft is distorted and the engine seizes. One of the predominant cause of bearing failure is accelerated wear of the top layers due to debris, reduced lubrication or manufacturing defects.

Assigned Session Code: FA7

Author: Kashani Pour

Co-Author(s): Amir Reza

Organization: Global Technology Connection

Paper Title: Probabilistic Corrosion Risk Modeling Based On A Digital Twin

Date / Time of Session Presentation: 5/16/2017 3:30:00 PM

Abstract:

"Digital twins" are computerized replicas of physical systems that help costly experimentation for capital-intensive assets. We proposed developing a digital twin approach to defining the spatially dependent structural health conditions (geometry, temperature profile, loading density of salt, relative humidity, stress) of a nuclear canister. This method can directly use a variety of existing FEA studies as apriori knowledge for a Bayesian model. We use a combination of probabilistic rules and deterministic corrosion model to apply to the digital twin model. The output is sets of spatial distributions of pits and cracks at a series of times since emplacement that will become the building block of the risk ranking matrix usable for the variety of decision-making model.

Assigned Session Code: DA4

Author: Eric Bechhoefer

Co-Author(s): Michael Augustin

Organization: GPMS Inc

Paper Title: Improving Safety Through Automated Helicopter Flight Data Monitoring

Date / Time of Session Presentation: 5/16/2017 1:30:00 PM

Abstract:

Automated HFDM provides improved metrics via automation of data download and reporting. In the extreme, robust HFDM provides protection of data even in the event of a mishap that would usually only available post mishap via crash survivable memory. This paper discusses the formalized concept of a flight operation, how regime recognition is used to support the function of an operation, and exceedance monitoring, in order to improve the robustness of a HFDM program.

Assigned Session Code: CBM6

Author: Rmdan Shnibha

Co-Author(s): Ghanant Al Arif

Organization: Harouge Oil Operations

Paper Title: Research into Reliable, Intelligent & Cost Effective use of Accelerometers for Condition Monitoring

Date / Time of Session Presentation: 5/16/2017 2:30:00 PM

Abstract:

This paper presents fundamental work being carried out on designing and building an intelligent monitoring system based on vibration measurements.

Assigned Session Code: PHM2

Author: Nakandhrakumar R S

Co-Author(s):

Organization: Hindustan Institute of Technology and Science

Paper Title: Development of Models for Tool Wear-Amplitude Ratio Relationship in Drilling

Date / Time of Session Presentation: 5/17/2017 11:00:00 AM

Abstract:

This paper presents a unique technique of mathematical model for on-line prediction of the drill flank wear in drilling using change in vibration amplitude. A mathematical model is developed to predict wear-time and the wear-amplitude ratio relationships during the drilling process. Such models are accurately determining drill flank wear development that has been achieved by using variation in vibration amplitude signals. The measurement of the variation in the ratio of amplitudes between torsional-axial dominant first mode (TP1) and second mode (TP2) frequency has been found to provide a practical method for an in-process approach to the quantification of tool wear and subsequent failure. A series of cutting tests are performed to study the effect of drill flank wear and also other independent cutting parameters on the vibration amplitude signals and to establish the relationship between the amplitude signals, drill flank wear and various other independent parameters. The drill flank wear and the ratio of amplitudes at different working conditions were collected experimentally to develop a mathematical model for predicting flank wear. The model was verified by comparing the experimental values with the predicted values. The relationship was then used for determination of drill flank wear.

Assigned Session Code: DA7

Author: James McGlone

Co-Author(s):

Organization: Kenexis

Paper Title: Smart Devices & Cyber Security Risks

Date / Time of Session Presentation: 5/16/2017 3:30:00 PM

Abstract:

Hardly a day goes by anymore without hearing about a cyber security event in the news. In this paper/session, we will analyze the risk associated with smart devices, calibration, and maintenance that could compromise the cyber security status of operations and possibly our entire companies. As a nuclear power plant operator and electronic technician, we never considered the security risk of having an instrument calibrated by a third party. Today however, things have changed significantly and it is common to find microprocessors in virtually everything including the instruments we are using in our plants. The microprocessor has made significant impacts in performance and communications and consequently might be weakening your organization's security. Analysis presented will discuss the real risk associated with different types of instrumentation and devices, network topologies, and technologies used in smart devices and systems. Additionally, we will analyze the possible effects on safety systems and how to compensate for them and how to protect your systems.

Assigned Session Code: CS2

Author: EJ Gunter

Co-Author(s): Brian K. Weaver

Organization: Mechanical and Aerospace Engineering Department, University Of Virginia

Paper Title: Analysis and Bearing-Damper Redesign for a $100 Million High Pressure Compressor Failure.

Date / Time of Session Presentation: 5/18/2017 9:00:00 AM

Abstract:

sent a PDF of final paper

Assigned Session Code: SYST1

Author: John Lucero

Co-Author(s):

Organization: NASA Glenn Research Center

Paper Title: The Design Process for an Aero-propulsion Test Rig

Date / Time of Session Presentation: 5/18/2017 8:30:00 AM

Abstract:

A team of NASA and Support Service Contractor Engineers at Glenn Research Center (GRC) was chartered to address the concern that the Advanced Noise Control Fan (ANCF) had served its useful life and that a new test capability was needed to enable the successful completion of NASA/Industry noise reduction program goals. From 2010 – 2015 a series of conceptual studies, stakeholder consultation and test demonstrations were held to develop a set of requirements and research roadmaps. As a result, funding was provided to procure a small turbofan that was identified which would fulfill research purposes of larger, more modern turbofan engines. This presentation will discuss the design process that was undertaken using the Systems Engineering Method to ensure successful design, build and implementation of the new test rig into the Aero-Acoustic Propulsion Laboratory at NASA GRC.

Assigned Session Code: 501

Author: Marc Hollins

Co-Author(s):

Organization: NAVAIR, Pax River

Paper Title: Algorithm Development using Mechanical Systems Diagnostic Analyzer (MSDA) Marc Hollins,

Date / Time of Session Presentation: 5/17/2017 1:30:00 PM

Abstract:

Assigned Session Code: FA1

Author: Dr. Vinod S. Agarwala, FASM, FNACE

Co-Author(s):

Organization: Naval Air Systems Command, U.S. Navy

Paper Title: Corrosion and Wear Resistance Through Modified Surfaces

Date / Time of Session Presentation: 5/16/2017 10:30:00 AM

Abstract:

Wear and corrosion are concomitantly occurring surface phenomena on rubbing metallic surfaces. As new surfaces are created during sliding/rubbing action, they become embryonic to surface reactions with the surrounding species of the service environment, in bearings, gears, pumps and rheological applications. through chemical and physical adsorption.

Assigned Session Code: HP2

Author: Jay Kudva

Co-Author(s):

Organization: nextgenaero

Paper Title: NextGen SHARP (Soldier Health Assessment and Real-time Proprioception) Sensor Suit

Date / Time of Session Presentation: 5/17/2017 11:00:00 AM

Abstract:

This paper presents work done by NextGen Aeronautics on design, fabrication, and testing of a formfitting body worn sensor suit called SHARP. SHARP was developed with a vision of seamless integration of human performance lab and body apparel; the complete SHARP system (including a miniature hipworn processing unit and batteries which provide continuous monitoring for several days) weighs less than 800 grams, is waterproof, comfortable for long-term wear, and does not interfere with the wearer's athletic or everyday activities. The focus for military customers is to quantitatively measure a soldier's gait, limb movements etc., indoors or outdoors, over extended periods of time, while she/he performs regular activities or is undergoing training.

Assigned Session Code: DIA12

Author: Joshua Tucker

Co-Author(s):

Organization: North Carolina Agricultural and Technical State University

Paper Title: Gear Box Acoustic Emissions Analysis

Date / Time of Session Presentation: 5/18/2017 11:30:00 AM

Abstract:

The use of acoustic emissions technology to diagnose faults in rotating mechanical systems has recently emerged as a viable diagnostic approach. This experiment involves the analysis of the acoustic signals emanating from a test gear box in which there are specific gear defects introduced to the system. The results collected from a specific set of gear defects are analyzed and compared in order to map out the explicit frequency data relating to those gear defects and to surmise the individual frequency patterns relating to gear defects, allowing for early detection of gear train catastrophic failure.

Assigned Session Code: FA9

Author: Thomas Hazelwood

Co-Author(s): Blake W. Van Hoy

Organization: Oak Ridge National Laboratory

Paper Title: Failure Analysis of a Reactor Pool Cooling Pump Using Modal and Vibration Analysis

Date / Time of Session Presentation: 5/16/2017 4:30:00 PM

Abstract:

Two 75 HP pumps redundantly supply cooling water to the reactor pool of the High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory (ORNL). Due to a recent history of premature bearing failures, one of these pumps has undergone maintenance to deal with possible issues of misalignment and base looseness. Vibration analysis and modal analysis including steady state spectrum, operational deflection shape, run up and down order tracking, and modal impact have been utilized to verify the effectiveness of the maintenance and identify possible remaining failure modes. The studies conclude that the pump is, after the maintenance, in an overall good conditional state as per ISO 10816, but a few failure modes remain. These modes consist of some shaft unbalance, considerable shaft misalignment intensified by piping movement, possible motor ground fault, hydrodynamic issues such as cavitation with modal interaction, and base looseness. These failure modes and their supporting data have been used to make suggestions for future maintenance, to verify the effectiveness of the previous maintenance, and to provide a base on which to check future data upon. This report will cover the testing setup, methodology, analysis results, and maintenance suggestions.

Assigned Session Code: 502

Author: Paul Howard

Co-Author(s):

Organization: Paul Howard Enterprises

Paper Title: A Short History of Oil Debris Diagnostic Technology – 50 Years of Progress

Date / Time of Session Presentation: 5/17/2017 2:15:00 PM

Abstract:

A Short History of Oil Debris Diagnostic Technology – 50 Years of Progress

Assigned Session Code: S6

Author: Dave Correlli

Co-Author(s):

Organization: PCB Piezotronics

Paper Title: How Sensor Mounting Significantly Affects Vibration Measurements

Date / Time of Session Presentation: 5/17/2017 4:30:00 PM

Abstract:

Assigned Session Code: DIA1

Author: Mantosh Bhattacharya

Co-Author(s):

Organization: Petrofac International

Paper Title: Peculiar cases of Pinion vibration in parallel shaft double helical gear units – Identification and

Date / Time of Session Presentation: 5/17/2017 10:30:00 AM

Abstract:

Industrial gear boxes used in turbo machinery trains are tested at full speed no load condition as mandated in API 613(Titled as -Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services). In this type of test, all possible aspects of incipient excitation of pinion cannot be captured. When a full load full speed complete unit test is carried out, pinion dynamic behavior is found to be different than what observed during full speed no load condition. During this test Gear Box

Assigned Session Code: PHM1

Author: Murtaza Hussain, PNEC, National University of Sciences and Technology

Co-Author(s): Asif Mansoor, Bahria University; Qaisar Ali

Paper Title: A Novel Approach for Machinery Health Prognostics Using Statistical Tools

Date / Time of Session Presentation: 5/17/2017 10:30:00 AM

Abstract:

Condition based maintenance of machinery is being much talked about in the engineering sector of defense and commercial industry. A lot of expenditure is generally incurred on condition monitoring of machinery to avoid unexpected downtimes and failures vis-à-vis optimizing machinery operation. The concept is ever evolving due to technological advancements as well as with the emergence of unique nature of defects. Vibration Analysis is a potent tool of condition monitoring for prediction and diagnostics of machinery failures. Presently, time and frequency spectra are being widely used for defect diagnostics of machinery. However, they require signal conditioning to eliminate noise and to enhance resolution of spectrum. Extensive research in the area of signal processing has been undertaken to refine time and frequency spectra. Notwithstanding application of statistical tools for analysis of various defects in machinery using condition monitoring data can be a viable option. Research in this area, where statistical models have been applied, revealed encouraging results. In this paper, we have modeled bearing vibration data by applying time varying Markov Switching Auto Regressive method which was found very helpful in estimating RUL of machinery.

Assigned Session Code: PHM6

Author: Luca Fumagalli

Co-Author(s):

Organization: Politecnico di Milano

Paper Title: Framework for PHM in Smart Manufacturing, Context:Integration of Different Approaches

Date / Time of Session Presentation: 5/17/2017 4:30:00 PM

Abstract:

The technology has advanced at an exponentially high rate since the advent of Internet in the early 90s. The concepts like e-maintenance, Internet of Things, Industry 4.0 are linked to this advancement in technology. All these have found great use in industries and manufacturing. This will boost predictive maintenance capabilities that will need to rely not only on consolidated algorithm and IT architecture, but also on new paradigms related with distributed computing, modularization of tools and development of predictive maintenance services. The paper will address such approach proposing a reference framework to highlight how predictive maintenance can be interpreted according to the new paradigm of Smart Manufacturing.

Assigned Session Code: T3

Author: Bill Pryor

Co-Author(s):

Organization: Predictive Maintenance Solutions, Inc.

Paper Title: Training: Fundamentals of Balancing

Date / Time of Session Presentation: 5/15/2017 8:30:00 AM

Abstract:

This one-day seminar will introduce balancing terminology and checklists, single-plane balancing, 2-plane balancing, and shop balance.

Assigned Session Code: S1

Author: Jeff Callen

Co-Author(s):

Organization: PSU

Paper Title: Distributed Temperature Sensing for Inspection of Electrical Panels on Navy Ships

Date / Time of Session Presentation: 5/17/2017 10:30:00 AM

Abstract:

Three different commercially available technologies have been identified for DTS: Raman shift, Rayleigh backscattering and Fiber Bragg Gratings. Each method has a different physical approach and different performance parameters. This project will perform a trade study of the different methods, including technical feasibility, implementation and maintenance issues and costs. Bench top demonstrations will be performed with down select to a final demonstration in an electrical panel representative of those on Navy ships.

Assigned Session Code: CS3

Author: Hendra Novi

Co-Author(s):

Organization: Pupuk Kaltim

Paper Title: Heat Balance on Steam Turbine Journal Bearing

Date / Time of Session Presentation: 5/18/2017 9:30:00 AM

Abstract:

Since 2008 several high temperature indications occur on steam turbine journal bearing. In this case study, lubrication was always blamed to be the root cause. Different analysis and solutions are performed with the final outcome and solution presented.

Assigned Session Code: HP9

Author: Mark Latino

Co-Author(s):

Organization: Reliability Center Inc.

Paper Title: Beyond Physical Failure: Understanding the Human Contribution

Date / Time of Session Presentation: 5/16/2017 4:30:00 PM

Abstract:

Assigned Session Code: SYST3

Author: James "Hoffy" Hoffmeister

Co-Author(s):

Organization: Ridgetop Group

Paper Title: Checkpoint (Save) and Restart (Restore) and Other Design Considerations

Date / Time of Session Presentation: 5/18/2017 9:30:00 AM

Abstract:

In this paper we present concepts and considerations to provide the reader with basic tools and knowledge as a base upon which to design the mechanics of a PHM system.

Assigned Session Code: PHM5

Author: James "Hoffy" Hoffmeister

Co-Author(s):

Organization: Ridgetop Group

Paper Title: An Approach to Processing Condition-based Data for Use in Prognostic Algorithms

Date / Time of Session Presentation: 5/17/2017 4:00:00 PM

Abstract:

Modern Prognostic Health Maintenance/Monitoring (PHM) systems use Condition-based Maintenance (CBM) algorithms to process Condition-based Data (CBD) to provide prognostic information and actionable imperatives to a system. Included in prognostic information are the following: estimate of remaining useful life (RUL); estimate of state-of-health (SoH); and estimate of time-to-failure (TTF) – also called prognostic horizon (PH). Algorithms, such as Kalman Filtering, are used to process CBD to project a future time when the data reaches a level indicative of failure – an estimated TTF.This paper discusses techniques and methods to first transform CBD into a Degradation Progression Signature (DPS) and then to transform DPS into a Functional Failure Signature (FFS): the latter is particularly amenable to processing by prognostic algorithms to produce estimates that rapidly converge to alpha (□□ accuracy bounds of five percent or better within a prognostic distance (PD) of less then 20 percent of the time between the PH at which functional failure occurs and the time when degradation is detected: typically, RUL converges to less than five percent error within 20% of the maximum PD.

Assigned Session Code: S4

Author: Linda Tomasi

Co-Author(s):

Organization: RSL Fiber Systems, LLC

Paper Title: Fiber Optic Distributed Temperature Sensing for Machinery Monitoring and Optimization

Date / Time of Session Presentation: 5/17/2017 3:30:00 PM

Abstract:

Temperature can indicate a variety of conditions on machinery and equipment including wear, electrical faults, cables' electrical load, and the formation of conditions leading to a fire. It is also a critical parameter in food storage areas, in rooms with sensitive electronic equipment, and in environments where explosive gases may be present.Temperature is typically monitored via discrete point sensors connected to a recording unit via wires or wireless. Fire detection is via smoke detectors. These approaches have several shortcomings: these sensors/ detectors need to be individually installed and moved if needed, accurate detection is just in the installed area, the sensors are susceptible to interference from other electrical components and in the case of smoke detection, the presence of smoke indicates that combustion is already in progress.Fiber optic sensors using Bragg Gratings address some of the shortcomings of electrical sensors however the sensing takes place only at the gratings in the optical fiber requiring precise placement in the location to be monitored. The Distributed Temperature Sensing (DTS) technology provides the benefits of fiber optics with virtually unlimited flexibility in the configuration of the detection locations and of the temperature conditions to be measured. DTS uses the entire length of communications grade optical fibers as a linear temperature sensor by detecting minute changes in the fibers' molecular structure. The specific zones of detection, the operating parameters, and the alarms can be individually set along the entire cable length and reconfigured as needed throughout the life of the system. Temperature changes of 0.5°C can be detected with a spatial resolution of 0.5 meters along upwards of 40 km of cable. DTS is used extensively in the oil and gas industry to monitor drilling operations and pipelines' leakage, in the transit industry to detect fires in tunnels, and is been applied to the food storage industry to prevent spoilage.The paper will analyze the DTS technology for machinery monitoring applications including equipment conditions based maintenance, fire prevention, thermal signature management, and other uses to optimize the monitoring and detection of temperature related conditions. A case study based on a recently completed trial to monitor an industrial refrigeration system will be illustrated

Assigned Session Code: CBM5

Author: Steffen Hinderer

Co-Author(s):

Organization: RWTH Aachen University

Paper Title: Observer Based Low Cost CMS for Predictive Maintenance of Wind Turbine Gear

Date / Time of Session Presentation: 5/16/2017 2:00:00 PM

Abstract:

Due to the continuous increase of nominal power in on- and offshore wind power plants, the loads on components such as the main bearing, main gearbox, generators and auxiliary drives are dramatically increasing. The Institute for Mineral Resources Machine Technology and the Chair for Wind Power Drives from RWTH Aachen University work together with certain industrial partners on a research project called BCMS: observer based low cost condition monitoring system for predictive maintenance of wind power plant gear boxes. An observer-based condition monitoring system uses measured real-time data like wind speed and torque to feed a parallel running simulation. The proposed CMS will improve the reliability of the prediction of component damages and component failures. Because of the portability and the modular design, existing plants can easily be equipped with the system. In this paper, the whole project will be presented and the advantages of an observer based condition monitoring system compared to the common systems on the market

Assigned Session Code: SA6

Author: Mohammed Meqqadmi

Co-Author(s):

Organization: SAFRAN AIRCRAFT ENGINES

Paper Title: System for Improving the Accuracy of Thrust Measurement of Turbine Engines

Date / Time of Session Presentation: 5/16/2017 2:30:00 PM

Abstract:

Turbofan main engine characteristics is its thrust. The engine is sold for a given thrust and cannot be deliver under a minimum thrust value. Hence it is fundamental to evaluate thrust with precision. However, the reception tests that verifies all engine functions before delivering to each airline company is done in different bench test cells, under different weather conditions and all those context variations implies that the measurement is far to be normalized. The objective is to make the thrust margin independent of the test conditions and to reduce its dispersion. This session presents a technique that has made it possible to reduce the dispersion by nearly a factor of 2.

Assigned Session Code: SA8

Author: Dany Abboud

Co-Author(s): Mohammed Elbadaoui

Organization: Safran Group

Paper Title: Comparing 2 Very Efficient Signal Processing Approaches for Vibration-Based CM of Rolling Bearings

Date / Time of Session Presentation: 5/16/2017 4:00:00 PM

Abstract:

This paper compares the most efficient signal processing in the field of bearing monitoring. The first is based on pre-processing the vibration signal through the maximum entropy deconvolution method (MED) followed by the spectral kurtosis (SK), before envelope analysis the obtained signal. The MED aims at maximizing the signal impulsivity by deconvolving the system transfer function through an optimization approach that maximize the kurtosis. Then, the spectral kurtosis (SK) define the optimal demodulation band before computing the envelope spectrum. The second approach is based on a cyclostationary modelling of the bearing signal. It applies the cyclic coherence to the signal with a special attention on setting the estimation parameters. These methods will be evaluated according to their potentiality to detect the fault in its earliest stage. The comparison will be made on real bearing vibration signals in run-to-failure tests.

Assigned Session Code: DIA3

Author: Jiao Liu, Harbin Institute of Technology

Co-Author(s): Myeongsu Kang, CALCE - University of Maryland Jinfu
Zhongqi Wang, Daren Yu, Harbin Institute of Technology
Michael G. Pecht, CALCE - University of Maryland

Paper Title: A Comparative Study on Anomaly Detection of Combustion Systems in Gas Turbines

Date / Time of Session Presentation: 5/17/2017 11:30:00 AM

Abstract:

Combustion systems, which are the core component of the gas turbine, frequently malfunction, causing catastrophic safety accidents, because they operate in the highly adverse environmental conditions of high temperature and high pressure. Hence, anomaly detection plays an important role in helping combustion systems run safely and economically. In recent decades, some methods have been published on anomaly detection of combustion systems in gas turbine. However, there is little research that compares these methods. This paper reviews these anomaly detection methods and provides analytical results. That is, an overall assessment of the merits or weaknesses of the generic methods is provided by testing the methods with actual gas turbine operating data. Additionally, some possible research developments are presented.

Assigned Session Code: S8

Author: Pratichi Vaidya

Co-Author(s):

Organization: Sensing Concepts

Paper Title: Deep-sea sensing - Advances and Challenges

Date / Time of Session Presentation: 5/18/2017 9:00:00 AM

Abstract:

Abstract - Last couple of years has witnessed a steep progress in the underwater communication technology. Issues arising from reflections, refractions, and energy dispersion associated with the medium are being addressed. It is now possible to transmit subsea data. It is also possible to have a deep sea network, thus making it possible to deploy an underwater distributed scalable sensor network. Modern underwater sensors with the help of latest advances in communication technology, can give an early indication of failure of subsea oil and gas equipment, leading to appropriate action well in advance. This is a step change for practicing subsea engineers. On one hand they want to move forward with the deployment of these sensors but on the other hand they still have to get confidence in the new technology and need a criterion to decide which sensor and the transmission technology is the most appropriate for their application. This paper is an attempt to fill this gap. It explains in short the fundamental physics, followed by the implementation details of communication channels via optical, acoustic and EM waves. It further discusses the recent advances in the sensor networks and gives recommendations about the suitability of each type with respect to a corresponding subsea situation.

Assigned Session Code: DIA10

Author: Keunsu Kim

Co-Author(s): Byeng D.Youn

Organization: Seoul National University

Paper Title: Degradation Modeling of an Actual Bearing Wear Process Using Vibration Signals

Date / Time of Session Presentation: 5/18/2017 10:30:00 AM

Abstract:

Failure of rolling element bearings is one of the critical causes of breakdowns in rotating machinery and common mechanical systems. The failure modes and mechanisms of bearings vary widely due to their various operating conditions. However, it has been proposed that in cases where the rolling element bearing is properly loaded, lubricated, installed, and kept free of foreign contaminants, the main mode of failure is material fatigue. Once an incipient fault is generated by material fatigue, rolling contact wear is the most frequently seen phenomenon. Many research studies have modeled the wear process of a bearing; however, each prior study has limitations that arise from the non-linearity of the wear process. In this study, therefore, we propose a degradation model that uses vibration signals and adds understanding of the physical status of the bearing during the wear process. To define the actual wear process of the bearing, we constructed and performed an experiment that represented in-situ bearing faults. From the vibration signal measured in the experiments, we extracted time domain and frequency domain features. In particular, we used spectral energy features that were obtained from the bearing characteristic frequencies (BCF), modulation signals of the BCF, and residual signals of the BCF. Then, we tracked the bearing degradation process with a health index that was compounded from the time domain and frequency domain features. As a result, we examined the process of bearing degradation as series of stages that relate to the conditions of the physical bearing. Using the proposed method, we expect to be able to predict the condition of the bearing without the need for destructive testing or visual inspection.

Assigned Session Code: DIA2

Author: Myungyon Kim

Co-Author(s): Byeng D.Youn

Organization: Seoul National University

Paper Title: Deep-Learning-Based Health Diagnosis Techniques for Journal Bearing Rotor Systems

Date / Time of Session Presentation: 5/17/2017 11:00:00 AM

Abstract:

Journal bearing rotor systems are frequently used in various industrial applications due to several advantages of journal bearing. In order to prevent any failures in these systems, several data-driven diagnosis techniques have been developed. In conventional diagnosis techniques, feature engineering process is the most important step, however this procedure is time-consuming, and expensive. It also requires considerable amount of physical, domain knowledge, and the features that were developed for one system could not be adopted to another system in general. To reduce the costs for developing proper features, deep learning based feature extraction method was developed in this paper.To develop the diagnosis algorithm, rotor vibration data acquired by proximity probe is used. Normally, journal bearing rotor systems use two probes installed orthogonally at each axial position. However, the information from the vibration data at each probe is not sufficient to predict the health state of the rotor systems correctly. By applying the omni-directional regeneration (ODR) technique, the vibration signals in different angular directions can be acquired. Using the ODR signals, vibration images that represent health states of the rotor system formed. Then without introducing other domain knowledge, convolutional neural network (CNN) which is known to be powerful in visual recognition is applied to extract the features from the image. To validate the proposed method, the deep learning approach is compared to conventional approach in terms of class prediction accuracy with the vibration data sets from a testbed. The results support the proposed approach of deep learning based feature extraction in diagnosis of journal bearing rotor systems. (UPDATED VIA EMAIL IN 11/28/16)

Assigned Session Code: SA7

Author: Suri Ganeriwala

Co-Author(s):

Organization: Spectra Quest, Inc.

Paper Title: Gearbox Bearing Fault Diagnosis Using Cepstrum Pre-whitening Technique

Date / Time of Session Presentation: 5/16/2017 3:30:00 PM

Abstract:

Bearings are a critical component in smooth operation of a gearbox. The vibration signals generated by bearings are impulsive, non-periodic, and low amplitude. The signals are often buried in the high-amplitude components like gears, imbalance, misalignment and random vibrations associated with friction and other sources. These effects make it difficult to identify bearing fault frequencies in the vibration data acquired on a typical gearbox bearing housings. To improve the diagnostics, it is important to increase the bearing fault signal-to-noise ratio. In this paper, a cepstrum pre-whitening technique was used to increase the bearing fault signal-to-noise ratio. Then envelope analysis with the optimized filter bands was applied to extract the fault features of bearings. Bearing fault vibration signals with different types of seeded faults were collected on a drive train diagnostics simulator (DDS). The test results have proven the effectiveness of the presented methodology.

Assigned Session Code: DA1

Author: Suri Ganeriwala

Co-Author(s):

Organization: Spectra Quest, Inc.

Paper Title: A Rational Basis for Determining Vibration Spectra of Shaft/Coupling Misalignment

Date / Time of Session Presentation: 5/16/2017 10:30:00 AM

Abstract:

This work is an evolution from the research performed on a large body of the vibration data to determine a unique vibration signature for shaft/coupling misalignment while operating under varying conditions such as speed, type and level of misalignment, coupling types and machinery dynamic stiffness. The data is analyzed from tests conducted on different machinery fault simulators operated at several shaft speeds, types of couplings, shaft diameters, structural stiffnesses, and multiple misalignment configurations. The results indicate a confusing picture of misalignment vibration signature. In this paper we present the results of vibration data analysis and outline an approach for vibration analysis of the shaft/coupling misalignment of rotating machines. This includes uses of rotor frequency response function and physics based predictive model.

Assigned Session Code: SA2

Author: Sawalhi Nader

Co-Author(s):

Organization: Spectra Quest, Inc.

Paper Title: A Simplified Physics Based Approach for Calculating Vibration Response of a Misaligned Rotor

Date / Time of Session Presentation: 5/16/2017 11:00:00 AM

Abstract:

Shaft Misalignment in machines is one of the main common problems, which continue to attract attention in the field of machine diagnosis. Misalignment results in preload forces at the couplings, which are then transmitted to the different components of the machine and in particular to the bearings, thus resulting in premature failure. In this paper, we present a simplified approach to extract the bearing vibration response of a misaligned rotor. The approach works on synthesizing the frequency response functions (FRFs) from a finite element model of the rotor. FRFs are synthesized between the location of the misalignment force at the coupling and the response location. The synthesized FRFs are used to obtain the impulse response function. The impulse response function is then convolved with forces at the coupling. To obtain misalignment forces at the coupling, the stiffness of the coupling, as a function of the rotational angle and the amount of misalignment, were measured and an interpolation model was developed and used. In this approach, only the synchronous part of the signal can be examined as the force response only contains the synchronous components of the signal, thus the response was examined in the frequency domain to study the effect of rotational speed on the vibration response.

Assigned Session Code: T1

Author: Suri Ganeriwala

Co-Author(s): Tony Barlow

Organization: Spectra Quest, Inc.; CHEVRON

Paper Title: Training: Hands-On Machine Vibration Analysis

Date / Time of Session Presentation: 5/14/2017 8:30:00 AM

Abstract:

This two-day course will include an overview of condition monitoring, instrumentation, and vibration theory; signal processing principles like sampling, resolution, aliasing, leakage, windowing, and step-by-step development of DFT. Hands-on experiments will be performed on misalignment, unbalance, bearing faults, induction motor faults using machinery fault simulators.

Assigned Session Code: DIA11

Author: Hasan Ferdowsi

Co-Author(s):

Organization: Texas A & M

Paper Title: Fault Detection and Estimation in a Class of Distributed Parameter Systems

Date / Time of Session Presentation: 5/18/2017 11:00:00 AM

Abstract:

In this paper, the problem of fault detection and isolation in a class of distributed parameter systems (DPS) will be investigated. The behavior of distributed parameter systems is best described by partial differential equation (PDE) models. However, due to complex nature of DPS, a PDE model is traditionally transformed into a finite set of ordinary differential equations (ODE) prior to the design of control or fault detection schemes by using significant approximations thus reducing the accuracy and reliability of the overall system. By contrast, in this paper, the PDE representation of the system is directly utilized to design the fault diagnosis scheme for DPS. Faults that can occur anywhere in the domain of the DPS (referred to as state faults) are considered, rather than only actuator and sensor faults. State faults are significantly more complicated to deal with in the case of DPS since they can be initiated anywhere within a continuous range of space, while in practice sensors are only available at limited locations which in many cases only include the input and/or output sides of the DPS. This problem is tackled by using an observer structure which includes input and output filters directly based on the PDE model of the system. A fault is detected by comparing the detection residual, which is the difference between measured and estimated outputs, with a predefined detection threshold. Once the fault is detected, an online approximator is activated to learn the fault function. An update law is introduced for updating the unknown parameters of the online approximator. The stability of the observer along with the online approximator will be discussed analytically in the paper. It is shown that one sensor is satisfactory for fault detection and approximation if the fault function has only one unknown parameter or can be expressed as linear in the unknown parameters. However, additional sensors are required for fault approximation or isolation in the general case. For example, a leakage fault in a pipeline has magnitude and location as unknown parameters and these parameters cannot be approximated by using one sensor. An algorithm is designed to approximate the location of a state fault with unknown magnitude by using multiple sensors. The distributed parameter systems considered in this paper are modeled by parabolic partial differential equations with Neumann or Dirichlet boundary conditions. Heat transfer systems and fluid pipelines are examples of

Assigned Session Code: DIA6

Author: Jorge Mijares

Co-Author(s): Bryan P. Rasmussen Alexander G. Parlos

Organization: Texas A & M

Paper Title: Detection of Lubrication Starvation in Ball Bearings and Impact in Lifetime

Date / Time of Session Presentation: 5/17/2017 4:30:00 PM

Abstract:

Inappropriate lubrication is the main cause of premature bearing failure, according to bearing manufacturers. The early detection and diagnosis of improper lubrication could maximize the bearing lifetime and avoiddowntime. This presentation challenges current approaches and corroborate certain methodologies.

Assigned Session Code: SA1

Author: Te Han

Co-Author(s):

Organization: Tsinghua University

Paper Title: App of adaptive local iterative filtering to fault feature extraction of bearing pedestal looseness

Date / Time of Session Presentation: 5/16/2017 10:30:00 AM

Abstract:

Due to the non-stationary and non-linear characteristics of the vibration signals from a wind turbine with bearing pedestal looseness fault, a novel adaptive decomposition technology called adaptive local iterative filtering (ALIF), which uses iterative filters strategy along with an adaptive and data-driven filter length selection, is applied to the fault diagnosis of bearing pedestal looseness in this work. Experimental analysis will be presented.

Assigned Session Code: SA4

Author: Nanfei Wang

Co-Author(s): Dong-xiang Jiang, Te Han

Organization: Tsinghua University

Paper Title: Misalignment Fault Detection in Dual-rotor System Based on Time Frequency Techniques

Date / Time of Session Presentation: 5/16/2017 1:30:00 PM

Abstract:

Experiments are carried out to obtain the vibration data of dual-rotor test rig and the results from the work show that the technique can be used for the monitoring of misalignment, which will have applications in the condition monitoring and maintenance of various types of rotating machinery.

Assigned Session Code: DIA5

Author: Yizhou Yang

Co-Author(s): Dongxiang Jiang

Organization: Tsinghua University

Paper Title: Rolling Bearing Fault Feature Extraction of Casing Vibration Signal

Date / Time of Session Presentation: 5/17/2017 4:00:00 PM

Abstract:

The health of rolling bearing plays a very important part in the operation of rotating machinery like gas turbine engine. Health monitoring and fault diagnosis of rolling bearing based on vibration signal has been through great development these years. But when sensors are set on the casing instead of the bearing pedestal, and the surrounding structure are very complex, the diagnosis problem becomes much more complicated, which brings the signal processing method more challenges. In this paper, a set of signal processing methods are used to enhance and extract the impact features from casing vibration signals, and to realize the detection of rolling bearing faults. A self-adaptive decomposition method called Intrinsic Time-scale Decomposition (ITD) is applied to separate the vibration signal into a series of components (so called proper rotation components) and a monotonic trend, which helps extracting dynamic features of the signal. The Teager-Kaiser Energy Operator is a simple algorithm calculating the energy of a signal, which is very sensitive to periodic impact fault. As the fault feature transferred to the casing is relatively week, autoregressive model (AR) and Minimum Entropy Deconvolution (MED) are here to enhance the non-stationary impact components of the signal. Experiments are conducted on the casing vibration test rig with minor defect in the bearing of the main shaft. Testing on the casing vibration signal, this fault feature enhancing and extracting method shows its remarkable ability in bearing fault diagnosis.

Assigned Session Code: S2

Author: Adrian Messer

Co-Author(s):

Organization: UE Systems, Inc.

Paper Title: Electrical Inspection Applications Using Airborne Ultrasound

Date / Time of Session Presentation: 5/17/2017 11:00:00 AM

Abstract:

Electrical Inspection Applications Using Airborne UltrasoundAirborne ultrasound has become a must have technology for maintenance & reliability professionals. Once considered just a compressed air leak detector, more individuals are using airborne ultrasound instruments for a multitude of applications. Including electrical inspection. The three propelling factors driving this application are: o Safetyo Electrical Maintenance Standards such as NFPA 70Bo Insurance Company ProceduresThis presentation will discuss how to use airborne ultrasound to detect corona, tracking, and arcing in energized electrical equipment. Information will also be presented on how to diagnose electrical faults when the sound is recorded an analyzed in a spectrum analysis software. Sound file examples will be used to show how ultrasound has become a more diagnostic tool for confirming electrical fault conditions.

Assigned Session Code: FA5

Author: Jordan Jameson

Co-Author(s): Michael H. Azarian Michael Pecht

Organization: Univeristy of Maryland

Paper Title: Thermal degradation of polyimide insulation and its effect on electromagnetic coil impedance

Date / Time of Session Presentation: 5/16/2017 2:00:00 PM

Abstract:

The failure of insulation in electromagnetic coils is a significant cause of coil failure and can have severe implications for the system. Due to excellent mechanical properties and ability to endure high temperatures, polyimide insulation is widely used in the electromagnetic coil manufacturing industry. This study provides an experimental analysis of how the insulation electrical parameters evolve over time, and their consequent effect on the coil impedance spectrum, thus providing useful empirical evidence for the value of impedance monitoring for electromagnetic coil insulation health monitoring.

Assigned Session Code: HP5

Author: Wolfgang Fink

Co-Author(s):

Organization: University of Arizona

Paper Title: Autonomous PHM for High Value Human Assets

Date / Time of Session Presentation: 5/17/2017 4:00:00 PM

Abstract:

PHM is traditionally applied in aerospace to help extend the remaining useful life of high value aerospace assets (i.e., airplanes, jet engines, etc.) at significantly reduced cost of maintenance. By analogy, astronauts, pilots, and warfighters are considered high value human assets because of the enormous financial investment in their training and education. In particular, crew health and performance are critical to successful human space exploration. Long-duration space missions bring numerous risks that must be understood and mitigated in order to keep astronauts healthy, rather than treat a diagnosed health disorder. Crewed missions venturing beyond Low Earth Orbit (LEO) and beyond (e.g., travel to the Moon and Mars) will require technology solutions for crew health care to address physiological, psychological, performance, and other needs in-situ, e.g., self-sufficiency, as an emergency or quick-return option will not be feasible. Therefore, onboard capabilities that would allow for early self-diagnosis of impending health issues, and autonomous identification of proper responses on negative trends to keep astronauts healthy are critical. With the absence of real-time medical ground support, personal health-tracking tools for health monitoring, health risk assessment and management are required for any crew member to predict her/his future health condition if no preventive measures are taken. It is important to stress that the frameworks of conventional medicine and even telemedicine are not viable/feasible as a healthcare concept for crew members, especially for long-duration space missions (e.g., flight to Mars) and eventual human settlement on other planetary bodies (e.g., Moon and Mars) where support and intervention from ground control on Earth is prohibitive because of distance. As such an autonomous healthcare concept is essential based on PHM principles to ensure crew health and ultimately mission success. Rather than treating problems medically, it is prudent to prevent them from happening in first place and/or to catch them early on where mitigation and interventions are still straightforward and not involved.

Assigned Session Code: HP8

Author: Hossein Davari Ardakani

Co-Author(s):

Organization: University of Cincinnati

Paper Title: Performance Monitoring of Soccer Players Using Physiological Signals and Predictive Analytics

Date / Time of Session Presentation: 5/18/2017 11:00:00 AM

Abstract:

This paper presents a predictive analytics framework for analyzing and predicting soccer players' performance data. The data consists of GPS and physiological measurements, collected from players during both practices and games using Zephyr Bioharness device. The proposed framework consists of data cleaning, filtering, visualizations and analytics modules to provide deeper insights into the data. The preprocessing modules automatically remove outliers using intelligent tools and determine first half, second half and potential overtime RISKS based on data patterns. Furthermore, comparison-based metrics have been developed to analyze the performance of players from different aspects including their activity level, fitness and consistency. For instance, Kolmogorov-Smirnov (KS) test was utilized to extract performance metrics based on players' Heart Rate and Speed, or a Neural Network-based approach was utilized to analyze the Heart Rate recovery rate of the players and quantify their recovery rate, which is important for effective play. At the end, different visualization tools were used to combine players' running patterns and speed profiles, along with various metrics. Interesting trends related to objective performance parameters could be observed for players during individual games and the entire season which can provide the athletic training staff with a better understanding of player's performance and inclines or declines in their performance.

Assigned Session Code: HP7

Author: Kim Bigalow

Co-Author(s): Mark Derriso

Organization: University of Dayton

Paper Title: Quantifying Enabling Factors for Human Performance

Date / Time of Session Presentation: 5/18/2017 10:30:00 AM

Abstract:

Assigned Session Code: FA3

Author: Nga Man Li

Co-Author(s):

Organization: University of Maryland

Paper Title: Shelf Life Evaluation Methods for Electronic and other Components Using a Physics-of-Failure (PoF) A

Date / Time of Session Presentation: 5/16/2017 11:30:00 AM

Abstract:

This paper demonstrates PoF based shelf life evaluation methods for several electronic and electromechanical parts with long term storage concerns, starting with Failure Mode, Mechanism and Effect Analysis (FMMEA) to identify the most critical element in each case. In addition, assembly storage assessment is also performed to show the impacts of processing and interconnects in storage level degradations.

Assigned Session Code: HP4

Author: Luke Nicolini

Co-Author(s):

Organization: University of Texas

Paper Title: Quantification of Forearm-Hand Muscle Dynamics and Fatigue Using Non-Restrictive Measurement Devices

Date / Time of Session Presentation: 5/17/2017 3:30:00 PM

Abstract:

In this paper, we investigate new technologies for quantifying the neuromusculoskeletal (NMS) dynamics of a human forearm-hand system. A new skin-mounted electromyography (EMG) measurement device based on stretchable sensor technology is developed and tested, along with a new implementation of Autoregressive Moving Average modeling with exogenous inputs (ARMAX modeling) for modeling and monitoring of NMS dynamics. These two innovations are combined and compared versus traditional skin-mounted electrodes in their ability to quantify muscle fatigue in both short and long-term scenarios. The new device is found to work comparably to traditional electrodes in single-day experiments, and performs superior to traditional electrodes in multi-day trials. Overall, the repeatability and sensitivity of the new devices, combined with the novel ARMAX model based approach to muscle fatigue modeling and monitoring, is shown to be an improvement over traditional fatigue quantification techniques.

Assigned Session Code: S3

Author: Daniel Schweickart

Co-Author(s):

Organization: US Air Force

Paper Title: Considerations for Failure Prevention in Aerospace Electrical Power Systems Utilizing Higher Voltage

Date / Time of Session Presentation: 5/17/2017 11:30:00 AM

Abstract:

Electrical power systems for advanced aircraft now utilize voltages well above the traditional levels of 12 to 42 Vdc and 115/200 Vac, 400 Hz. Current airborne systems can contain 270 Vdc, and bipolar systems with a 540 V differential are appearing in certain flight vehicles. Electrical and electronic equipment used in aerospace applications must be designed to operate over a wide range of environmental conditions that include variations in pressure, temperature, and humidity. Higher dc potentials create increased probability of arcing and flashover compared to the risks associated with traditional ac or low-voltage dc. The low pressures of high altitude environments only serve to worsen such concerns. This presentation will address the development of a guideline document containing methods of managing higher voltages in aerospace vehicles. Based upon both current and archival work, the design guidance provides a basis for identifying high voltage design risks, defines areas of concern as a function of environment, potential risk mitigation methods and test and evaluation techniques. Some of the key areas of concern are power conversion devices, electrical machines, connectors and cabling/wiring, as well as interactions between components and subsystems. The document is focused on electrical discharge mechanisms including partial discharge and does not address personnel safety. It is intended for application to high voltage systems used in aerospace vehicles operating to a maximum altitude of 30,000 m. (approximately 100,000 ft.), and maximum operating voltages of below 1500 Volts-RMS. Fundamental issues addressing some of the key areas will be described and discussed.

Assigned Session Code: HP1

Author: Lloyd Tripp PhD.

Co-Author(s):

Organization: US Air Force-711th Human Performance Wing

Warfighter interface Division

Paper Title: Flight Helmet Mounted Physiological Monitoring

Date / Time of Session Presentation: 5/17/2017 10:30:00 AM

Abstract:

The flight environment has always posed a physiological hazards to aircrew who fly high-performance aircraft. This has recently come to light for both the US Air Force and US Navy with reports of hypoxic like symptoms in-flight. The US Air Force Research Laboratory, Navy Medical Research Unit Dayton and an Elbit Systems, an Israeli commercial helmet systems company have teamed up to develop a helmet mounted physiological monitoring and warning system, which measures arterial oxygen saturation, pulse rate and head-level blood perfusion. This system is designed to monitor and warn of impending hypoxia or G-Induced Loss of Consciousness (G-LOC).

Assigned Session Code: FA2

Author: Marc Pepi

Co-Author(s): Carl Paxton

Organization: US ARMY RESEARCH LABORATORY

Paper Title: Repair of Simulated Battle Damage Utilizing Cold Spray Technology

Date / Time of Session Presentation: 5/16/2017 11:00:00 AM

Abstract:

ARL researched the feasibility of cold spray repairing aluminum armor panels with simulated battle damage. The through-holes were filled utilizing aluminum powder with the CGT4000 cold spray equipment. The repairs were deemed successful, since the objective was to provide protection against anticipated chemical, biological, radiological and nuclear (CBRN) exposure, and to make the armor air and water tight.

Assigned Session Code: HP6

Author: Ben Leever

Co-Author(s): Laura A. Sowards Jeremy W. Ward

Organization: USAF

Paper Title: Materials and Manufacturing Challenges for Wearable Electronics in Aerospace Applications

Date / Time of Session Presentation: 5/17/2017 4:30:00 PM

Abstract:

For wearable devices to meet the Air Force's requirements for both data fidelity and device ruggedness, the emerging ecosystem in flexible hybrid electronics (FHE) manufacturing is expected to be critical. In support of this ecosystem, AFRL has been developing functional inks for the 3D printing of flexible or stretchable circuit elements as well as processes for integrating ultra-thin or unpackaged silicon die into these flexible circuits. The presentation will also describe an external AFRL program that will identify the physics of failure for wearable devices to enable predictive reliability models and to identify opportunities to improve manufacturing processes for wearable devices. Finally, the role of two public-private partnerships with significant focus in manufacturing of wearables devices will be described. The AFRL Nano-Bio Manufacturing Consortium has led nearly $20M in projects to develop materials and manufacturing processes for wearable devices ranging from sensors for hydration status to concussive impact to lactate concentration in saliva. NextFlex, America's Flexible Hybrid Electronics Manufacturing Institute, is investing $180M over five years to advance FHE technology from MRL/TRL 4 to 7, including a number of projects focused on the manufacturing of wearable electronics for health and performance monitoring.

Assigned Session Code: S12

Author: George Zusman

Co-Author(s):

Organization: Vibration Measurement Solutions, Inc.

Paper Title: Two-Wire IEPE or CLD Electronics Interface Sensors with Integrated Mechanical Transducing and Temper

Date / Time of Session Presentation: 5/18/2017 11:30:00 AM

Abstract:

Typical vibration sensors configuration for condition monitoring having a piezoelectric or MEM transducer an integrated preamplifier and a two-wire interface connected via a cable to a constant current (IEPE - Integrated Electronics Piezoelectric) or constant voltage (CLD - Current Line Drive) power source for power input, and to a data acquisition circuit for signal output.Such sensors are often installed at locations that are remote from monitoring equipment that evaluates the sensor output. To overcome the noise and interference inherent in such environments, line drive piezoelectric or MEM sensors have been developed that combine a piezoelectric or MEM transducer and a built-in preamplifier that transforms the high impedance mode output of the transducer into a low impedance voltage or current output signal. A two-wire interface and associated two-wire cable (such as a coaxial cable) connects the sensor to a remote constant current or constant voltage power source for power input, and to a remote data acquisition circuit for signal output. The two-wire cable may be as long as several hundred meters. In some sensor designs, the sensor is powered by a constant current power source (IEPE) and the sensor's output is a modulated bias voltage signal. In other sensor designs, the sensor is powered by a constant voltage (CLD) power source and the sensor's output is a modulated current signal.Line drive piezoelectric or MEM sensors as described above are designed to measure only a single parameter, such as vibration. If an additional parameter needs to be measured, such as temperature in situations where the both parameters are needed to be monitored in the measurement point, a separate output and lengthy wire connection to a remote unit are required which required three-wire connection. This redundancy adds design complexity and expense and sometimes required to exchange all sensors and wiring system to be implemented.This paper introduces integrated sensor that combines mechanical transducing with temperature monitoring using the bias voltage or current DC value for measure the temperature and AC bias value for measure the vibration. Design of offered sensor is based on the voltage summing amplifier outputs a time-varying voltage output embodying a composite waveform that represents a summation of the transducer waveform and the temperature waveform, with voltage biasing provided by the reference voltage from the voltage reference source.The structure, spe

Assigned Session Code: DA2

Author: John Van Baren

Co-Author(s): Aaron Offringa

Organization: Vibration Research

Paper Title: Using Fatigue Damage Spectrum for Accelerated Testing with Correlation to End-Use Environment

Date / Time of Session Presentation: 5/16/2017 11:00:00 AM

Abstract:

The accumulated damage that a product experiences in the field due to the variety of vibration stresses placed upon it will eventually cause failures in the product. The failure modes resulting from these dynamic stresses can be replicated in the laboratory and correlated to end use environment to validate target reliability requirements. This presentation addresses three fundamental questions about developing accelerated random vibration stress tests. Question #1: What random profile is needed (and for how much time) to accurately simulate the end use environment over the life-cycle of my product?Question #2: My product operates in many different vibration environments, how can I confidently combine them into one accelerated test?Question #3: How can I use the FDS to accelerate my test?

Assigned Session Code: DIA7

Author: Turki Haj-Mohamad

Co-Author(s):

Organization: Villanova Univeristy

Paper Title: Gear Fault Diagnostics by Extended Phase Space Topology

Date / Time of Session Presentation: 5/18/2017 8:30:00 AM

Abstract:

Maintenance costs constitute a major part of operating costs in any industry. This has motivated industries to adopt best machine condition monitoring techniques so that costs can be reduced and productivity can be increased. In any machine, gears are one of the most important transmission elements where the availability of the entire system depends on the proper function of gears. There is an ever-increasing demand to enhance the performance and service life of gears. It is hence important to be able to find defects in gears before they lead to failure.Many techniques such as frequency/ quefrency analysis, time/ statistical analysis, time frequency analysis have been developed to detect the various faults. However, most of them suffer from low detection quality and or slow response time which restrict their use in online or real time fault detection applications.This paper introduces a novel feature extraction method, called the extended phase space topology method (EPST), for diagnostics of gear-trains. The feature vectors are created by representing the vibrational signal as a density, which is then expanded in a basis of orthogonal functions. Further, the coefficients of the orthogonal functions are considered as input feature vectors to characterize the density distribution of different conditions, and an artificial neural network is trained and used as a classifier.The

Assigned Session Code: K4

Author: Diego Galar

Co-Author(s):

Organization: Division of Operation and Maintenance Engineering Luleå University of Technology

Paper Title: Keynote: eMaintenance in Military Context

Date / Time of Session Presentation: 5/17/2017 9:15:00 AM

Abstract:

Assigned Session Code: K3

Author: Patrick, PhD Mason

Co-Author(s):

Organization: Department Head, Warfighter Performance; Office of Naval Research

Paper Title: Keynote: Introduction of Emerging Field of Human Performance to MFPT

Date / Time of Session Presentation: 5/17/2017 8:30:00 AM

Abstract:

Assigned Session Code: CBM4

Author: Michael Roa

Co-Author(s):

Organization: Ship Engineering Department, Government Projects ABS Americas

Paper Title: Introduction to the ABS Guidance Notes on Equipment Condition Monitoring Techniques

Date / Time of Session Presentation: 5/16/2017 1:30:00 PM

Abstract:

Assigned Session Code: PHM4

Author: Bin Huang

Co-Author(s): Yuan Di, Chao Jin and Jay Lee

Organization: NSF I/UCRC for Intelligent Maintenance Systems (IMS), University of Cincinnati

Paper Title: A Review of Data-driven Methods in Prognostics and Health Management: Lessons Learned from Prognostics and Health Management Data Challenge Competitions

Date / Time of Session Presentation: 5/17/2017 3:30:00 PM

Abstract:

Machine learning and statistical algorithms are receiving considerable attention during the past decade in prognostics and health management (PHM). Data-driven methods have expedited the research in predicting and root causing asset faults, and many industrial sectors are beginning to benefit from reduced downtime and increased productivity. However, there is a lack of consensus and methodology on algorithm selection in different scenarios, which renders the random implementation of machine learning algorithms and inefficient development processes. PHM Data Challenge, an open data competition specialized in PHM, includes diverse issues in industrial data analytics and thus provides abundant resource for study and appropriate approach development. This study aims at providing a generalized algorithm selection strategy by reviewing the PHM Data Challenge winning algorithms in the past decade. A comparative study is presented to summarize the similarities and differences in different scenarios, discuss about why the winning algorithm outperforms others, and conclude how to select an algorithm facing a particular scenario. The resulting algorithm selection strategy is applied to an industrial case study to demonstrate a step-by-step process on algorithm selection and to validate the necessity, effectiveness, and efficiency of implementing it.