Hindawi Publishing Corporation
International Journal of Aerospace Engineering
Volume 2013, Article ID 348532, 2 pages
http://dx.doi.org/10.1155/2013/348532

Hindawi

Editorial

Condition-Based Maintenance

Nezih Mrad,[1] Peter Foote,[2] Victor Giurgiutiu,[3] and Jérôme Pinsonnault[4]

[1] *Defence Research and Development Canada (DRDC), Centre for Security Science (CSS), National Defence Headquarters, Ottawa, ON, Canada K1A 0K7*
[2] *Manufacturing and Materials Deptartment, School of Applied Sciences, Cranfield University, Cranfield, Bedfordshire MK43 0AL, UK*
[3] *Department of Mechanical Engineering, University of South Carolina, Columbia, SC 29208, USA*
[4] *Bombardier Aerospace, Station Centre-ville, Montreal, QC, Canada H3C 3G9*

Correspondence should be addressed to Nezih Mrad; nezih.mrad@drdc-rddc.gc.ca

Received 27 January 2013; Accepted 27 January 2013

The drive to reduce aircraft operation and support (O&S) costs, increase platform availability, and enhance their performance and safety has motivated researchers, technology developers, aircraft manufacturers, and fleet operators to explore effective concepts, methodologies, and technologies as an alternative to the traditional schedule-based maintenance philosophy.

Condition-based maintenance (CBM), also known as "predictive maintenance," is a maintenance practice that derives maintenance requirements, in large part, from real-time assessment of platform or weapon system condition obtained from embedded sensors and/or external tests and measurements using built-in diagnostic equipment. When coupled with real-time asset data, sophisticated materials, and structural and propulsion models, it promises the delivery of enhanced effectiveness of maintenance programs, preventing unplanned downtime, making better use of maintenance resources, and maximizing the operational life of the asset.

Our analysis indicated that the areas with the highest level of contribution to CBM are sensor technologies, health assessment and analytics (diagnostic and prognostic methods), communications technologies, and decisions support. This issue on CBM addresses all identified areas and focuses on maturing the understanding of the contributing concepts and technologies to achieve a wider implementation of CBM, particularly in the aerospace and defence sectors.

Miller presented the use of a systems' engineering approach to guide the development of integrated instrumentation/sensor systems (IISS) and concluded that such approach provides clear benefits in identifying the overall system requirements and architectural framework for categorizing and evaluating alternative architectures. While Miller effectively addressed the instrumentation functional features such as interrogation of sensor types, sensors interfaces, multiplexing, and communication to provide flexibility and rapid system reconfiguration to adapt to evolving sensor and data needs, G. Rinaldi et al. focused on a specific structural issue and presented a novel approach to aid in shifting time-based maintenance schedules towards condition-based maintenance procedures. The proposed novel approach demonstrated the innovation in the design of integrated microelectromechanical- (MEMS-) based multiparameters sensing using carbon nanotube/polyaniline polymer sensors for corrosion sensing and monitoring of aircraft structural materials (e.g., aluminium alloys). Through fusion of the multiparameters sensor data (chloride ion concentration, hydrogen gas evolution, humidity variations, and material degradation), a corrosion index was developed to be used in a condition-based maintenance protocol consisting of both preventative and corrective maintenance scheduling. Due to the criticality of sensor data in the CBM framework, Zhigang et al. presented a meticulous and well-thought-out review of piezoelectric-based acoustic wave generation and detection techniques for structural applications. They reviewed a variety of ingenious ways on how piezoelectric transducers are used in today's structural health monitoring (SHM) methodologies as a means for generation and/or detection of diagnostic acoustic waves. Although this review presented three different approaches, all-piezoelectric

approaches, hybrid approaches, and wireless excitation and detection techniques, these can easily be integrated to provide a more powerful solution to specific problems (e.g., wireless fiber-acoustic approach).

While the above discussed contributions focused on addressing sensor issues for structural applications, L. Jiang and A. Corber presented a thermal fluid dynamics modeling and analysis of a gas turbine engine combustor. This effort is to define the aerothermodynamic working environments and service histories that will enable the assessment of the remaining life of gas turbine critical components, hence significantly reducing the cost and time of gas turbine engine fleet management. Their results illustrated a complicated (uneven distribution) flow features inside a combustor and the need for future improved modeling tools.

Not only key processes, technologies, concepts, and methodologies are critical to the cost-effective implementation of efficient CBM but also decisions support. S. Horning et al. developed and demonstrated an operational readiness simulator for optimizing maintenance activities and operational availability focussing on a rotary wing aircraft. The developed simulator provides a synthetic environment to forecast and assess the ability of a fleet, squadron, or aircraft to achieve the desired flying rates and the capability of the sustainment systems to respond to the resultant demands, while maintaining efficient and optimized maintenance program. They used this virtual simulator to assess several operational scenarios including adjustment of preventative maintenance schedules, including impact of condition-based maintenance, variation of the annual flying rate, and investigation of deployment options.

By compiling these selected papers, we hope to provide an opportunity to researchers, practitioners, and operators with the opportunity to enrich their knowledge in increasing the operational acceptability of the condition-based maintenance approach, particularly within the aerospace sector and air weapons systems.

Nezih Mrad
Peter Foote
Victor Giurgiutiu
Jérôme Pinsonnault