Toward Reliable Engineered System Design: Reliability-Based Design and Prognostics and Health Management (PHM)

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Abstract

Failures of engineered systems could not only result in enormous repair/replacement costs, but also cause life-threatening consequences such as explosion and fire. Since the 1980s, major industries and government agencies worldwide have faced increasing challenges in ensuring the reliability and safety of engineered systems. Examples of failures in attaining high reliability are the Chernobyl disaster in Russia (1986), the collapse of I-35W Mississippi River Bridge in U.S. (2007), and the lithium-ion battery fire/smoke on Boeing 787 Dreamliners in U.S. and Japan (2013). In response to these reliability challenges, reliability-based design and prognostics and health management (PHM) techniques have been developed. At the design stage, reliability-based design ensures high reliability of an engineered system through reliability analysis and design change. PHM, on the other hand, utilizes sensory signals collected at the operation stage to monitor the system's health condition, predict its remaining useful life, and ultimately prevent catastrophic failures from occurring. This talk overviews both reliability-based design and PHM techniques. Several industrial applications including US Army vehicle control arm design, power transformer health monitoring and prognostics, and lithium-ion battery prognostics will be used for the demonstration of the two techniques.

Presenter Bio

Dr. Chao Hu received his B.E. degree in Engineering Physics from Tsinghua University in Beijing, China in 2003, and the Ph.D. degree in mechanical engineering at the University of Maryland, College Park in Maryland, USA. He is currently working as a Principle Scientist at Medtronic, Inc. in Minnesota, USA. His research interests are reliability-based design, design of energy storage systems, and prognostics and health management (PHM). Dr. Hu has received several awards and recognitions for his research, including: the Star of Excellence Individual Award at Medtronic in 2014; the Best Paper Award in the ASME Design Automation Conferences (DAC) in 2013; a nomination for the 2013 Eni Award Renewable Energy Prize, known as "Nobel Prize in Energy Sector"; the Best Paper Award in the IEEE PHM Conference in 2012; and two-time receipts of the Top 10 Best Paper Award in the ASME DACs in 2011 and 2012. His research work has led to more than 40 publications in the above areas.