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Health management of complex system based on performance degradation

Susan Lu[1] and **Huitian Lu**[2]
[1]Binghamton University, SUNY, USA
[2]South Dakota State University, USA

System health management with remaining useful life (RUL) and performance reliability assessment is based on the system degradation with aging and usage. The degradation is a stochastic process. The performance reliability is assessed by system degradation, which is the probability ofthe degradation reaching to or exceeding over a predefined threshold of a "soft-failure." The system maintenance plan will be then decided based on predicted conditions in terms of failure probabilities and the associated costs of downtime, failure, maintenance, labor, etc. This methodology and the framework are proposed in use of state-space model and nonlinear filtering for general nonlinear, time-variant, non-Gaussian dynamic systems. Sequence Monte Carlo method is developed to provide online recursive estimation for both model parameter and the system state for reliability dynamics. Performance reliability prediction and RUL estimate are intended for system prognostics and health management (PHM), and the decision on the time for components to remanufacture in management consideration. The proposed approach will overcome the disadvantages of fixed-time period maintenance and available maintenance strategies commonly used in industry. It will advance the traditional reliability and maintainability methods from a static model to a dynamical environment, from off-line estimation to an on-line prediction, and from population attention to each individual consideration for complexity. The approach could significantly enhance system performance and minimize life cycle costs. This research includes a proposed prototype of a computer monitoring system, a type of online 'reliability odometer', capable to indicate the conditional reliability of a complex system at any given time instance.

Biography

Susan Lu received the BS degree in mechanical engineering from Hebei University, Hebei, China, the MS degrees in mechanical engineering from Tianjin University, Tianjin, China, and the PhD degree in industrial engineering from Texas Tech University, Lubbock, respectively. She is an Associate Professor with the Department of Systems Science and Industrial Engineering, State University of New York at Binghamton, Binghamton, NY. Her current research interests include solar cell reliability and manufacturing process optimization, pattern recognition for sensor array system. Dr. Lu is a member of the IIE and Alpha Pi Mu. Huitian Luis a professor with Department of Construction & Operations Management at South Dakota State University. He received the MS and PhD in industrial engineering from Texas Tech Universityin 1992 and 1998 respectively. Professor Lu has more than 16 years of experience in academic teaching and research. His research interests include system reliability modeling, system stochastic dynamics, theory of remaining useful life, healthcare system dynamics and improvement, nonlinear filtering and applications, etc. Professor Lu is the member of IIE, ASA, SAIM, INFORM and Alpha Pi Mu.

Slu@binghamton.edu

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