2015 Guangbin Yang Reliability Symposium

Reliability Assessment, Warranty and Design of Repairable Systems Using Reliability Topologies and Counting Processes

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ABSTRACT

Most engineering systems are repairable. Their components can be repaired or renewed, if system failure occurs, to put the system back into service. This presentation will describe methodologies to first assess the reliability of repairable systems and then use it to design such systems considering the tradeoff between reliability and lifecycle cost. Reliability usually degrades with time, increasing the product lifecycle cost.

We will describe methods to deduce the system architecture (fault tree or reliability block diagram) from limited data using a reliability topology approach. We will also determine which system architectures lead to the best cost-performance tradeoff, and what performance metrics can best assess the reliability of a repairable system. In addition, we will explore a Pareto front method for the optimal design of a repairable system. Repair assumptions such as "same-as-old," "good-as-new," "better-than-old-but-worse-than-new" and "worse-than-old" will be accounted using renewal process modeling. Finally, an approach to forecast warranty of a vehicle fleet will be presented. Different examples will highlight all developments.

Bayesian Probability Papers

Vasiliy Krivtsov
Senior Staff Technical Specialist, Ford Motor Company, and Mark Kaminskiy, NASA Goddard Space Flight Center, ManTech International Corporation

ABSTRACT

In reliability/risk analysis studies, the traditional probability paper technique is applied to the location-scale family of distributions, whose CDF can be linearized in the way that the distribution parameters are estimated through the linear regression model: $y=ax+b$. It is shown that the Bayesian regression model can be efficiently applied to the probability paper procedure thus resulting in Bayesian Probability Papers. Prior information about the distribution model parameters can be included as pseudo data points

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in the Y- and X-matrices of the regression model. The approach is illustrated by an accelerated fatigue life test of induction-hardened steel ball joints.

Failure Prediction and Performance Degradation in Automotive Manufacturing

Ahad Ali
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Failure prediction and remaining useful life identification is one of the major issues in reliability. Proper tools and techniques can help to reduce faults based on performance degradation analysis. This talk will provide some key methods and applications in automotive manufacturing. The implementation of reliability tools is very challenging. Many tools could be developed. However executions of those tools are critical to see a great value added for the product and system reliability. The automotive industry can use those tools for fault reduction and performance improvement.

AVL: Using AVL's LOAD MATRIX™ Methodology to Develop Reliability Demonstration Plans

Bernard Stubitsch
AVL

When developing a reliability demonstration plan, it is common for companies to use standard test cycles which have been used for many years. There are several benefits to this approach: results can be compared to prior programs and products, expected results over the duration of the test are known, and test development and validation time is eliminated, to name a few.

However, there are also risks associated with relying solely on these legacy reliability test cycles. Existing test specifications were likely developed on surrogate products or systems, and there may be weak or even no correlation to current customer usage. Without correlation to customer usage, there is a potential to either over- or under-test, based on useful life requirements. Over-testing has obvious negative implications related to higher development costs and over-designing of products. Even worse, if products are under-tested, critical failure modes may be found too late or missed entirely during reliability testing, resulting in high warranty costs and customer dissatisfaction.

AVL's LOAD MATRIXTM is our internal process for development of reliability demonstration plans. It begins with identification of critical component failure mode combinations, and utilizes a well-defined customer duty cycle