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Editorial

Mathematical Applications to Reliability and Maintenance Problems in Engineering Systems

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Reliability and maintenance are well known concepts, which contribute to retaining engineering systems in their functioning states. Reliability is one of the fundamental criteria in engineering systems design and maintenance serves to support it throughout the systems life. As such, maintenance acts in parallel to production and can have a great impact on the availability and capacity of production and on the quality of the products. For this reason, it deserves great attention, careful planning, and continuous improvement.

To inform the strategic decision-making on reliability and maintenance of engineering systems, mathematical models and optimization techniques have long been used. These models and techniques can help in achieving the desired target of system reliability and retain it with cost-effective maintenance.

The interest in the mathematical models and optimization techniques for system reliability and maintenance is demonstrated by the over 90 papers submitted to this special issue. Finally after an intense and rigorous reviewing process, 13 papers were selected for publication.

The paper entitled "Prognostics and Health Management: A Review on Data Driven Approaches" presents an extensive review on the stochastic processes and regression-based models for Prognostics and Health Management (PHM), based on available monitored data. Some practical examples and applications are also illustrated.

The paper entitled "Accelerated Testing with Multiple Failure Modes under Several Temperature Conditions" illustrates an accelerated testing procedure, in which both high temperatures and low temperatures are applied to a product. This allows building the reliability function of the product by statistical analysis, accounting for multiple failure modes and variable working conditions.

The work by M. Kayid et al. introduces and studies a new stochastic order called proportional mean residual life order. Several characterizations and preservation properties of the new order under some reliability operations are discussed.

The paper by Y. Chen et al. addresses the reliability analysis of a two-component, cold-standby system with a single repairman, who may have vacations. The paper derives a number of classical reliability indices under such condition: system availability, system reliability, the rate of occurrence of system failures, and the mean time to the first failure of the system.

In the paper entitled "Gear Crack Level Classification Based on EMD and EDT," the authors use Empirical Mode Decomposition to process vibration signals and, then, the Euclidean Distance Technique to measure the (Euclidean) similarity between the test sample and samples from four classes, for gear crack fault classification. The results obtained show that the proposed method has high accuracy rates in classifying different crack levels and in adaptive to different conditions.

X. Li and C. Zhang present a paper titled "Delayed Age Replacement Policy with Uncertain Lifetime." The authors consider the delayed age replacement policy with uncertain

lifetimes and find that the optimal replacement time is irrelevant to the uncertain distribution of lifetime of the first unit, over the infinite time span.

Y. Gao et al. propose a new scheme of health index prediction, which utilizes multiple relevant time series to enhance the completeness of the information and adopt a prediction model based on least squares support vector regression to perform the health trend prediction.

Z. Hajej et al. in their paper develop a mathematical model to study the lease contract with basic and extended warranty, based on a win-win relationship between the lessee and the lessor. The influence of the production rates is considered to determine a theoretical condition under which a compromise-pricing zone exists, under different schemes of maintenance policies.

P. Gao and L. Xie develop a fuzzy dynamic reliability model for parallel mechanical systems, with respect to stress and strength parameters. A practical example is chosen to demonstrate the proposed model.

Y. Tang et al. develop a delay time-based model for optimization of inspection intervals, which is completely based on maintenance data for estimating the model parameters. Then, they illustrate the method on a filter and a blowout preventer rubber core.

The availability of sufficient data for reliability and maintenance modeling is always a problem in applications. In this regard, Y. Peng et al. present a method to estimate the uncertainty intervals of the failure probability estimate by Weibull distributions, in the case of no available failure data. Some engineering experience or hypothesis testing is required for the set-up of the shape parameter.

Y. Zhang et al. present an active learning Kriging solution to calculate moment-independent importance measures based on the failure probability. Two numerical examples and two engineering examples are analyzed to demonstrate the significance of the proposed parametric sensitivity index, as well as the efficiency and precision of the calculation method.

A. Kibria et al. address the problem of estimating the failure rate of a component and provide a simulation-based optimization method for the minimization of the discrepancy between the simulated and the historical percentages of failures for turbine engine components. The method can be considered as a decision-making tool for maintenance, repair, and overhaul.

Acknowledgments

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