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Design Optimization for the Step-Stress Accelerated Degradation Test under Tweedie Exponential Dispersion Process

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The accelerated degradation test (ADT) is a popular tool for assessing the reliability characteristics of highly reliable products. Henceforth, designing an efficient ADT has been of great interest, and it has been studied under various well-known stochastic degradation processes, including Wiener process, gamma process, and inverse Gaussian process. In this work, Tweedie exponential dispersion process is considered as a unified model for general degradation paths, including the aforementioned processes as special cases. Its flexibility can provide better fits to the degradation data and thereby improve the reliability analyses. For computational tractability, the saddle-point approximation method is applied to approximate its density. Based on this framework, the design optimization for the step-stress ADT is formulated under the C-optimality. Under the constraint that the total experimental cost does not exceed a pre-specified budget, the optimal design parameters such as measurement frequency and test termination time are determined via minimizing the approximate variance of the estimated mean time to failure of a product/device under the normal operating condition.

Keywords

Accelerated degradation test; Exponential dispersion process; Step-stress loading

Special/invited session

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