

A new approach to fitting the three-parameter Weibull distribution: An application to glass ceramics

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Abstract-

The field of strength reliability is one of the critical factors restricting wider use of brittle materials in certain structural applications, like ceramics. In this area, the Weibull distribution is widely accepted for lifetime modeling. In essence, the brittleness of ceramic materials leads to poor toughness and low strength reliability. The statistical nature of these flaws results in a significant scatter of the measured macroscopic strength outcomes, which has a number of consequences both in the design and verification of components involving such materials. In this article, an analysis and evaluation of six existing estimation methods for a Weibull distribution are presented, as well as a new approach for fitting the Weibull distribution using neural networks (NNs). The major focus of this work is, however, the implementation of simulations in order to contrast how well the suggested techniques of the Weibull parameter estimation perform. Finally, an important implication of this study is that it shows how various estimators of the Weibull model work for wide-ranging sample sizes and different parameter values. The simulation results revealed that L-Moment estimator produces more accurate estimates, unlike those using NNs that are more robust with the lowest Root Mean Square Error.

Index Terms- Weibull strength distribution, brittle materials, ceramics, parameter estimation neural networks

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