On the on-line estimation of lifetime for a multi-element system of unknown size with random element strengths

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Abstract

A number of failure models for a multi-element system under an increasing external load are considered. We assume the elements of the system to have random breaking strength values drawn from some common distribution. A basic example of such a model is the famous fiber bundle model with equal-load sharing [1].

For all the models we consider a quasi-static process of load increasing and associated progressing failure and discuss the estimation of time remaining to global breakdown of the system (i.e., when all the elements are broken). The inner structure of the system and the distribution of element strengths are assumed to be known, while the size of the system (the total number of elements) is considered as unknown.

The estimates obtained do not depend on the size of the system. The way of deriving the estimates is a development of the ideas and methods of [2,3]: attention is paid primarily to statistical analysis of a burst sequence, where burst is a simultaneous failure of a number of elements under current total load. During the whole load increase process the burst sizes and the time intervals between the consecutive bursts are recorded, the burst size being the number of elements forming it. The accumulated sequences are on-line analyzed in terms of the random process theory.

Statistical properties of the derived estimates are discussed. Theoretical results are compared with ones obtained using extensive computer simulation.

References

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