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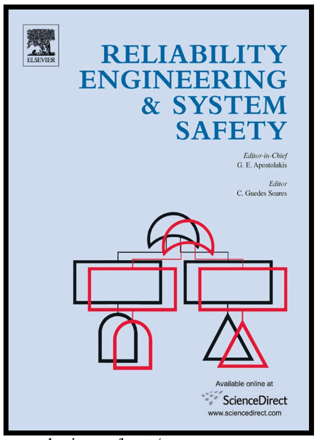

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Jensen-Shannon information of the coherent system lifetime

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Abstract

The signature of a coherent system with n components is an n-dimensional vector whose ith element is the probability that the ith failure of the components is fatal to the system. The signature depends only on the system design and provides useful tools for comparison of systems. We propose the Jensen-Shannon information (JS) criteria for comparison of systems, which is a scalar function of the signature and ranks systems based on their designs. The JS of a system is interpreted in terms of the remaining uncertainty about the system lifetime, the utility of dependence between the lifetime and the number of failures of components fatal to the system, and the Bayesian decision theory. The JS is non-negative and its minimum is attained by k-out-of-n systems, which are the least complex systems. This property offers JS as a measure of complexity of a system. Effects of expansion of a system on JS are studied. Application examples include comparisons of various sets of new systems and used but still working systems discussed in the literature. We also give an upper bound for the JS at the general level and compare it with a known upper bound.

Keywords: Coherent system; entropy; k-out-of-n system; mixture; order statistics; signature.

1 Introduction

During the last two decades two growing streams of research on comparison of systems have emerged in the reliability theory literature. An important development in reliability theory originated by Samaniego [30] and further developed by Kochar et al [17] is the mixture representation of the distribution of lifetime of a coherent system consisting of components with homogeneous lifetimes. A stream of research applies the mixture representation of the system reliability function to compare systems based on probabilities of the number of component failures that can cause a system to fail; see, [12, 16, 22, 28, 38] for references and latest developments. A different stream of research applies the information theory of Shannon [33] and Kullback-Leibler [20] to compare systems in terms of

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