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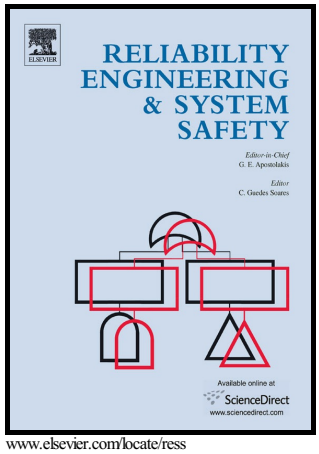

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Reliability of Multi-state Systems with a Performance Sharing Group of Limited Size

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Abstract

Previous research in series systems assumes that each element must satisfy its own demand individually. However, the surplus performance from some elements can be transmitted to other deficient elements in some practical systems such as power generating systems and collaborative computing systems. In this paper, we consider a series system with a performance sharing group of limited size, i.e., the number of elements that can be connected into the performance sharing group is limited. It is assumed that the elements connected into the performance sharing group can change dynamically when the state of the system changes in order to minimize the possible performance deficiency of the system. A reliability evaluation algorithm is proposed for the suggested system and the optimal connection strategy is discussed. Numerical experiments are conducted to illustrate the applications.

Keywords: multi-state reliability; performance sharing; universal generating function; series system; optimal connection

List of Notations

e_i : multi-state element i
G_i : random performance of e_i
W_i : random demand of e_i
C : random transmission capacity of the common bus
M : number of elements that can be connected to the common bus
N : number of elements within the series system
S_i : random performance surplus of e_i
D_i : random performance deficiency of e_i
X_i : random difference between performance and demand of e_i
S : total performance surplus that can be transmitted
D : total performance deficiency that can be replenished

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