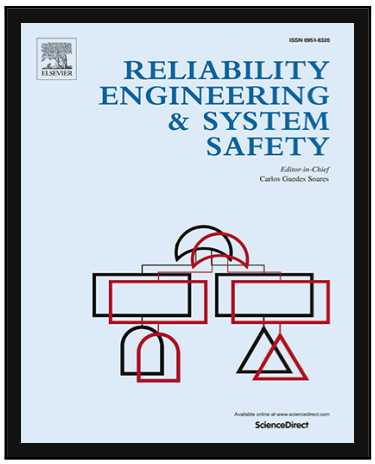

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Constructing a Markov process for modelling a reliability system under multiple failures and replacements

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Abstract

We present a reliability system subject to shocks, internal failures, and inspections. Shocks cause damage or failure to several units simultaneously. The units undergo internal failures. After an inspection, the units that have failed are replaced by new and identical ones. The shocks are governed by a Poisson process, the internal failures and the inspection times are exponentially distributed. Under these assumptions a Markov process governing the system is constructed. The states of the system are formed by state-vectors associated to the units of the system. The instantaneous transitions among the states are constructed by using intermediate functions and indicators. A system with three components illustrating the procedure is studied and a numerical application is performed, comparing the performance measures of the k-out-of-3 systems for k = 1, 2, 3.

Key words: Markov process; Reliability system; Multiple failures; Availability; Multiple replacements

1 Introduction

The occurrence of simultaneous failures is frequent in certain types of multi-component systems. For example, in metheo stations in remote areas under severe environmental conditions, concurrence failures take place to the installed devices for registering external measures. In this case, the maintenance usually is performed by inspections replacing the failed components by new and identical ones. The high-performance computing systems are organized by thousands of computing nodes, these form clusters where the nodes are very close, and a