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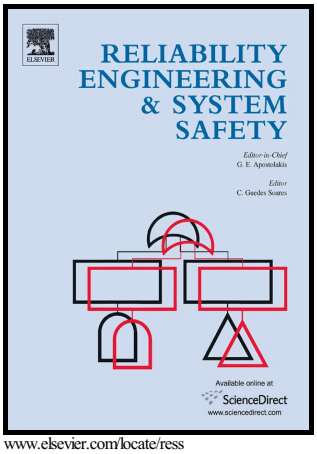

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On preventive maintenance of systems with lifetimes dependent on a random shock process

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Abstract

We consider preventive maintenance (age replacement) of items operating in a random environment modeled by a Poisson process of shocks. An item is replaced either on failure or on the predetermined replacement time, whichever comes first. Each shock in our stochastic model has a double effect. On one hand, it acts directly on the failure rate of an item, which results in the corresponding stochastic failure rate process. On the other hand, each shock causes additional 'damage', which can be attributed, e.g., to a short drop in the output of an item. The corresponding optimization problem is considered and illustrated by detailed numerical examples.

Keywords: Shock process, Poisson process, preventive maintenace, age replacement, intensity process

1. Introduction

Due to its exceptional practical importance, the literature on preventive maintenance consists of thousands of papers and a number of books entirely devoted to this topic (see, e.g., Nakagawa [23], Gertsbakh [16], Wang and Pham [27], Wang [26]). One can also observe an increasing interest in maintenance modeling (including preventive maintenance (PM), condition-based maintenance, etc.) of systems subject to external shocks, as shocks effecting systems during its operation are common in practice and constitute a useful tool for describing the effect of environment on reliability characteristics of engineering systems. (see, e.g., Caballé et al. [3], Castro [4], Castro et al [5], Montoro-Cazorla et al [22]. Montoro-Cazorla and Pérez-Ocón [21], van der Weide and Pandey [28] and Ruiz-Castro [25] to name a few). Recently, Finkelstein and Gertsbakh [14, 15] were discussing these problems using signatures for the description of the relevant properties of the structure function of a coherent system. The important feature of the approach developed in the latter papers is that the number of experienced shocks was for the first time in the literature considered as a parameter for preventive maintenance, i.e., the PM was performed either on failure or observing the predetermined number of shocks, whichever comes first.

In the current paper, we consider the traditional time-scale for PM: the replacement occurs either on failure, or at the predetermined time *T,* whichever comes first. However, the shock process in our model has a double effect. On one hand, it acts directly on the failure rate of an item, which results in the corresponding stochastic failure rate process; on the other