Maintenance planning for a deteriorating production process

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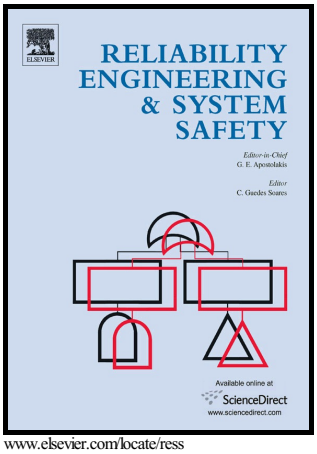

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Maintenance planning for a deteriorating production process

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Abstract

We consider a system subject to degradation, more precisely a production process with three quality states evolving according to a homogeneous Markov process. The degradation decreases the income generated by the system. To maintain revenue stream and prevent the loss of revenue, the system is inspected according to a Markov-modulated Poisson process. It is assumed that each inspection at time t incurs a time dependent cost. Each inspection improves the system health and therefore the degradation level jumps to a less deteriorated state. In absence of inspections, the system state is prone to shift to a more deteriorated state with a constant rate. The problem is to determine an optimal operating (stopping) time which truly balances some flow of income and increasing costs due to inspections, and so maximizes the expected gain of the proposed policy. To demonstrate the applicability of the explored approach and its effectiveness, some numerical results are provided.

Keywords: Replacement policy; degrading system; Markov-modulated Poisson process; Forward Kolmogorov equations; Stopping time; Reward; Production process; Quality state.

Notation

$N(t)$	Counting process, the numbers of inspections at time t
$X(t)$	Quality state at time t, time homogeneous Markov process
λ_{X_t}	Inspection intensity modulated by the quality state
γ_i	Transition rate to state i in absence of inspections
$p_i(n,t)$	Probability of being in quality state i after n inspections at time t
$\Pi_i(t)$	Sojourn time distribution of the process in quality state i