

Condition Based Maintenance Policies for a 2-out-of-3 Redundant System under Imperfect Maintenance Actions

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Abstract

This study develops a continuous-time Markovian degradation model for a 2-out-of-3 redundant system where the actual health state of the components can only be assessed through periodic, error-prone inspections. All the components degrade independently based on an identical distribution. Both Type-I and Type-II inspection errors are possible. Furthermore, the maintenance actions can be imperfect, meaning that the repaired components can be in states between 'as good as new' and 'as bad as old'. We propose a Markov Decision Process (MDP) approach to optimize both the frequency of inspections and the selection of maintenance actions. We construct and evaluate dynamic heuristic policies based on the observed system condition. The objective is to identify the best maintenance strategy and the corresponding inspection schedule that jointly minimizes the expected limiting cost rate by balancing inspection and maintenance expenditures against the system downtime cost. Through numerical analysis, we quantify the value of applying redundancy-aware preventive maintenance policies when inspections are error-prone. We also conduct numerical sensitivity analysis to demonstrate the effect of various maintenance parameters on the optimum maintenance policy.

Keywords

Predictive Maintenance, Stochastic Models, Reliability, Inspection and Maintenance Policy.

Biography

Salih Tekin is an Assistant Professor at TOBB University of Economics and Technology. He received his B.S. degree in Industrial Engineering from Bilkent University, Ankara, Turkey, in 2002, and M.S. and Ph.D. degrees in Industrial Engineering from Georgia Institute of Technology, GA, USA, in 2006 and 2011, respectively. He also has an M.S degree in statistics from Georgia Institute of Technology, GA, USA, earned in 2004. His current interests include reliability and applied probability models.