

Optimal Maintenance Policy for a Three-Unit System

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Abstract : We study the condition-based maintenance (CBM) problem of a system subject to stochastic deterioration. The system is composed of three units (or modules): (i) Module 1 deterioration follows a Markov process with two operational states and one failure state. The operational states are partially observable through periodic condition monitoring. (ii) Module 2 deterioration follows a Gamma process with a known failure threshold. The deterioration level of this module is fully observable through periodic inspections. (iii) Only the operating age information is available of Module 3. The lifetime of this module has a general distribution. A CBM policy prescribes when to initiate a maintenance intervention and which modules to repair during intervention. Our objective is to determine the optimal CBM policy minimizing the long-run expected average cost of operating the system. This is achieved by formulating a Markov decision process (MDP) and developing the value iteration algorithm for solving the MDP. We provide numerical examples illustrating the cost-effectiveness of the optimal CBM policy through a comparison with heuristic policies commonly found in the literature.

Keywords : reliability, maintenance optimization, Markov decision process, heuristics

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