Chiel van Oosterom

Optimal Maintenance Policies for a Markovian deteriorating system with population heterogeneity

Abstract
We develop a partially observable Markov decision process (POMDP) model to incorporate population heterogeneity when scheduling replacements for a deteriorating system. The single-component system deteriorates over a finite set of condition states according to a Markov chain. By scheduling replacements, the objective is to minimize total expected discounted operating and replacement cost over an infinite horizon. In contrast to the existing literature, we allow the population of spare components that is available for replacements to be composed of different component types. Those cannot be distinguished by their exterior, but deteriorate according to different transition matrices. This situation arises, for example, if new components and repaired components are mixed into the population without proper records of their repair history. Analogously to the literature for homogeneous spare component populations, we provide a set of conditions that enable to characterize the structure of the optimal policy. By a numerical experiment, we benchmark our POMDP model against straightforward approaches that neglect population heterogeneity.

C.D. van Oosterom, H. Peng, G.J. van Houtum