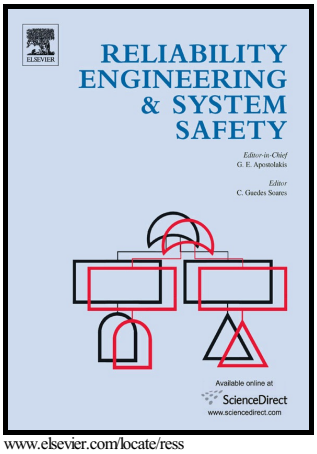

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Parameter Inference for Non-Repairable Multi-State System Reliability Models by Multi-Level Observation Sequences

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ABSTRACT

Multi-state system reliability theory has received considerable attention in recent years, as it is able to characterize the multi-state nature and complicated deterioration process of systems in a finer fashion than that of binary-state system models. Parameter inference for multi-state system reliability models, which is a task that precedes reliability evaluation and optimization, is an interesting topic to be investigated. In this paper, a new parameter inference method, which aggregates observation sequences from multiple levels of a system, is developed. The proposed inference method generally consists of two stages: (1) compute the sequences of the posterior state probability distributions of units based on multi-level observation sequences by dynamic Bayesian network models and (2) estimate the unknown transition probabilities of units by converting the sequences of posterior state probability distributions into a least squares problem. Two illustrative examples, together with a set of comparative studies, are presented to demonstrate the effectiveness and efficiency of the proposed method.

KEYWORDS: multi-state system (MSS), Bayesian networks, parameter inference, multi-level observation sequences

ABBREVIATIONS

MSS	Multi-State System
BN	Bayesian Network
DBN	Dynamic Bayesian Network
TM	Transition Matrix
SPSPD	Sequence of Posterior State Probability Distribution
CPT	Conditional Probability Table
DAG	Directed Acyclic Graph

NOTATIONS

$G_l(t)$	Performance capacity of unit *l* at time *t*.