Universal generating function based recursive algorithms for reliability evaluation of multi-state weighted k-out-of-n systems

A multi-state k-out-of-n system model provides a flexible tool for evaluating vulnerability and reliability of critical infrastructures such as electric power systems. The multi-state weighted k-out-of-n system model is the generalization of the multi-state k-out-of-n system model, where the component i in state j carries a certain utility contributing to the system's performance. However, the computational efficiency has become the crucial factor for reliability evaluation of large scale multi-state k-out-of-n systems. Li et al. proposed recursive algorithms for reliability evaluation of the multi-state weighted k-out-of-n systems. The well-known universal generating function (UGF) approach was also used as a counterpart to compare with the developed recursive algorithms, which is not very efficient. In this paper, a transformation of the conventional UGF formula is proposed to develop a UGF-based recursive algorithm, which can improve computational efficiency. A graphical interpretation is also presented for the proposed approach, which uses the concept of Accompanying Tree.

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