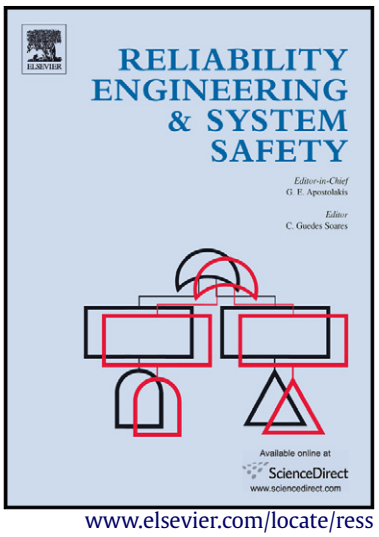

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Importance Analysis based on Logical Differential Calculus and Binary Decision Diagram

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System availability evaluation, sensitivity analysis, importance measures, and optimal design are important issues that have become research topics for reliability engineering. There are different mathematical approaches to the development of these topics. The structure function based approach is one of them. Structure function enables one to analyse a system of any complexity. But computational complexity of structure function based methods is time consuming for large-scale networks. We propose to use two mathematical approaches for decision to this problem for system importance analysis. The first of them is Direct Partial Boolean Derivative. New equations for calculating the importance measures are developed in terms of these derivatives. The second is Binary Decision Diagram (BDD), that supports efficient manipulation of Boolean algebra. Two algorithms for calculating Direct Partial Boolean Derivative based on BDD of structure function are proposed in this paper. The experimental results show the efficiency of new algorithms for calculating Direct Partial Boolean Derivative and importance measures.

Keywords: Importance measures
Binary Decision Diagram
Logical Differential Calculus

1. Introduction

A mathematical representation and description of the initial object is an important step in reliability analysis. There are some types of mathematical models in reliability analysis and one of them is the structure function of a system that is defined by one-to-one mapping of system state and states of the system components. The structure function can be interpreted as Boolean function if the initial system has two possible states as functioning and failure only and the system analysed in