Reliability optimization of a redundant system with failure dependencies

Haiyang Yu\textsuperscript{a}, Chengbin Chu\textsuperscript{a,b}, Éric Châtelet\textsuperscript{a} and Farouk Yalaoui\textsuperscript{a}

\textsuperscript{a}Institute Charles Delaunay (ICD, FRE CNRS 2848), Troyes University of Technology, Rue Marie Curie, BP 2060, 10010 Troyes, France

\textsuperscript{b}Management School, Hefei University of Technology, 193 Tunxi Road, Hefei, China

Abstract

In a multi-component system, the failure of one component can reduce the system reliability in two aspects: loss of the reliability contribution of this failed component, and the reconfiguration of the system, e.g., the redistribution of the system loading. The system reconfiguration can be triggered by the component failures as well as by adding redundancies. Hence, dependency is essential for the design of a multi-component system.

In this paper, we study the design of a redundant system with the consideration of a specific kind of failure dependency, i.e., the redundant dependency. The dependence function is introduced to quantify the redundant dependency. With the dependence function, the redundant dependencies are further classified as independence, weak, linear, and strong dependencies. In addition, this classification is useful in that it facilitates the optimization resolution of the system design. Finally, an example is presented to illustrate the concept of redundant dependency and its application in system design. This paper thus conveys the significance of failure dependencies in the reliability optimization of systems.

Keywords: Redundant dependency; Dependence function; Reliability optimisation; Markov system

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