SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering - Methods, Processes and Tools (1) (3)

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OPTIMAL RECONFIGURABILITY DESIGN FOR SPACECRAFT BASED ON FUNCTION TREE

Abstract

With the development of the space technology, security, reliability and maintainability requirements have been highly enhanced for spacecrafts. Since reconfiguration technology can effectively reduce the fault effect, it has become an important method to guarantee reliability and survival capability for spacecrafts. Accordingly, excellent reconfigurability is necessary for spacecrafts and how to increase spacecraft reconfigurability has further become a key issue in practical engineering. In order to fundamentally improve the reconfiguration ability of spacecrafts, reconfigurability should be considered in design stage, and the reconfigurability design method must be involved to guide the system design. In literature, most related research has focused on fault tolerant controller design, and is difficult to guide the system configuration design. Although some scholars have discussed reconfigurability from the intrinsic and performance-based perspectives, they have not involved system components and cannot suit for the complex system. Consequently, the objective of this paper is to construct an optimal reconfigurability design method based on function tree. First, some basic definitions relating to spacecraft reconfigurability are given. Then, on the basis of function tree, a reconfigurability modeling method is established to describe system's configuration characteristics. Quantitative reconfigurability indexes are further presented and a weak link analysis approach is proposed via the model. In addition, considering reliability constraints, an optimal design method of system configuration is given based on the minimal path set of the reconfigurability model. Finally, the proposed methodology is illustrated and verified in practical analyzing for spacecraft control system. Results show that the method can realize the system configuration design by synthetically considering components, configuration and reconfiguration strategies, and is suitable for the complex system such as spacecrafts.