Reliability and Cost Focused Optimization Approach for a Communication Satellite Payload Redundancy Allocation Problem

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Abstract : A typical reliability engineering problem regarding communication satellites has been considered to determine redundancy allocation scheme of power amplifiers within payload transponder module, whose dominant function is to amplify power levels of the received signals from the Earth, through maximizing reliability against mass, power, and other technical limitations. Adding each redundant power amplifier component increases not only reliability but also hardware, testing, and launch cost of a satellite. This study investigates a multi-objective approach used in order to solve Redundancy Allocation Problem (RAP) for a communication satellite payload transponder, focusing on design cost due to redundancy and reliability factors. The main purpose is to find the optimum power amplifier redundancy configuration satisfying reliability and capacity thresholds simultaneously instead of analyzing respectively or independently. A mathematical model and calculation approach are instituted including objective function definitions, and then, the problem is solved analytically with different input parameters in MATLAB environment. Example results showed that payload capacity and failure rate of power amplifiers have remarkable effects on the solution and also processing time.