

SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)

Space Technology and System Management Practices and Tools (4)

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BASED ON CENTRAL COMPOSITE DESIGN METHOD SATELLITE MISSION DESIGN

Abstract

In conceptual design phase, the goal of the satellite mission design is to gain a feasible solution. Satellite mission design involves many domains that are coupling with each other. Usually the domain factors are nonlinear and the interactive effects exist. Therefore, it is difficult to find the best solution if only analyzed one domain factors' main effect. Coupling relationship between the domains must be considered. During the satellite design process, the design team should determine which factors have main effects and which factors have interactive effects. According to the response surfaces, the design team can select the best feasible solution. In this paper, a central composite design method was described. The central composite design method is an optimization method based on statistical data analysis. And it is also a response surface design method. In this method, the design factors are divided into two subsets. One subset is used to estimate the linear and interactive effects. The other subset is used to estimate the curve effects. This method uses the minimum tests to gain the variables and variance information. And it can provide the main effect, interactive effect in a graphical fashion. An earth observation satellite mission is exemplified. The mission objects include two points. One is to maximize the coverage time for a regional area, and the other is to minimize the satellite cost. The simulation models are established on orbit prediction, the visible field, data transmission, and satellite cost. 8 design factors are selected and 145 tests are performed. The simulation results show the satellite altitude has main effect on the coverage time but has extremely small effect on the cost. The aperture diameter and EIRP have the main effect on the cost. However, the combination of a small aperture diameter and a high satellite altitude leads to the violation of the resolution constraint. The center composite design method is dependent for each domain design model. The design method is able to steer the choices of the design team in a graphical fashion.