MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

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OPTIMUM DESIGN OF SPACE FRAME AND ITS APPLICATION IN SATELLITE STRUCTURE

Abstract

This paper reports a practical approach for the optimization of three-dimensional space frame with parametrized element cross sections and its application in satellite structure design. The mass of the structure is to be minimized subject to constraints which include nodal displacements and rotations, material stress, modal frequencies, and design variable side constraints. The structure is represented by a finite element model using a twelve degree of freedom (two end nodes, with three displacements and three rotations per node) frame element. Figure 1 details the rectangular, thin-walled cross section for the ith element.

Considering Engineering structural optimization problems usually include large number of constraints and design variables, which can be properly posed as high-order implicit nonlinear mathematical problems. In order to improve convergence and calculation efficiency in solving these problems, a two-level multipoint approximation concept was adopted to establish the separable approximate problem which can be solved easily by using dual theory of mathematical programming. With FEM and the high efficient structural optimum algorithm, two typical frames (Bartel structure see figure 2, 2x5 grillage see figure 3)will be analyzed and optimized first, and the results will be compared with the results provided in published papers.

After that, the frame in a satellite structure (see figure 4) will be modeled and optimized. The mass can be decreased with the required modal frequencies constraints. Example and practical problems are solved, showing that this approach to the frame problem is useful and efficient.