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Author: Mr. Tatsuki Kawai
Meijo University, Japan

Dr. Atsuhiko Senba
Meijo University, Japan

OPTIMAL DESIGN OF THE BACK TRUSS STRUCTURE FOR MINIMIZING THE DEFORMATION OF REFLECTOR UNDER GRAVITY

Abstract

This study proposes a method to reduce the deformation of the space reflector based on a homologues theory. By designing the mass distribution of the truss type back structure, a desired deformation property of the truss can be achieved. The reflector is subjected to thermal variation and gravity force in the operational environment for the VLBI (very long baseline interferometry). Since the thermal deformation can be effectively reduced by using a kinematic coupling technique between the reflector and back structure, the deformation due to gravity is a focus of this study.

In order to reduce the deformation of the truss, we used the particle swarm optimization (PSO) technique to randomly search the optimal truss shape and the location of the additional masses. The objective function of the optimization is a homologous criteria. The criteria is the root mean square (RMS) of the difference between two displacements for any combinations of the truss nodes.

First, we analyzes the deformation characteristics of two-dimensional and three-dimensional truss structures that are supposed to be used as a supporting structure for the reflector of an antenna in gravity environment. To control the ideal shape of the reflector of an antenna, a method for adjusting the deformation of the truss is proposed by using the effect of the weight of the additional masses that are fixed at specific nodes of the truss. The deformation of the supporting structure for various elevation angles and temperature variation are analyzed. As a result, ideal position of the additional masses and ideal shape of the truss are simultaneously obtained for two-dimensional truss. Then, a three-dimensional truss design is performed for realistic simulation. The reduction of the RMS as a results of placing additional masses are finally discussed.