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THE DEVELOPMENT OF AN ENERGY AND INFORMATION TRANSMISSION SYSTEM UTILIZING THE CONDUCTIVE ELEMENTS OF TRANSFORMABLE SPACE ANTENNAS

Abstract

Various designs of space reflectors are employed to address the challenges of space exploration and satellite communication. One of the actively evolving areas is the development of large-sized deployable systems. These systems are characterized by the significant importance of the relationship between the volume of the reflector when it is deployed and the volume when it is in its stowed position, which is due to the need to transport the antenna into orbit within a launch vehicle.

During the operation of large space-based reflector systems, it is necessary to adjust and maintain a specified shape of the radio reflecting surface. Ensuring that this requirement is met allows for improved quality in the transmitted and received signals. Due to the operating conditions in space, the system is subject to significant disturbances such as temperature variations, cosmic radiation, and solar wind. These factors can cause changes in the position of the large structure, leading to oscillations. Additionally, the control of the parabolic antenna's shape and the resulting measurement noise must be considered.

In this work, we propose a novel method for configuring the reflective surface of a large-scale space reflector by utilizing its conductive structural components. The design of an actuator has been developed that allows for controlling multiple actuation points. We present the results of applying various control algorithms to the actuator, which enable smooth adjustment of the network considering minimization of energy expenditure and design fluctuations.

Based on simulation results, an optimal algorithm for the hierarchy of target criteria showed greater stability with respect to convergence in the presence of measurement noise and disturbances. This allows for real-time application.

These findings can be utilized to calculate energy expenditure, select an actuating device, and design an energy system for a space-based reflector.

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