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MODELLING OF SPACE ANTENNA DEPLOYMENT USING OPEN SOURCE SOFTWARE

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The goal of this article is to develop a dynamic model of a space antenna with the pantograph structure and to study the processes of its deployment using open-source software. Methods of theoretical mechanics, multibody dynamics, computational mechanics, and computer modeling were used in the research.

A mesh antenna of the novel design, which is recommended for mini-satellites, is considered as the object for modeling. The most significant difference between this antenna and others is the design of the support ring in the form of a pantograph.

To develop a model of the space antenna dynamics and implement it using open-source software, some simplifications were made due to the complexity of the structure. The antenna model is represented as a system of rigid and flexible bodies connected by hinges. Carbon fiber rods are modeled with the help of a flexible finite element using the method of absolute nodal coordinates, which allows one to model large deformations of the structure. Aluminum hinge assemblies are modeled as several rotation joints connected by conventional rigid elements. The main modeled properties of these hinge assemblies are the stiffness, location, and direction of the axes of rotation of the hinges. The tension forces created by the stretched mesh are modeled using springs. The cable drive of the antenna deployment mechanism is modeled as a load acting on the corresponding elements in defined local positions.

An algorithm for building a model of the space antenna to simulate the reflector deployment process in the HotInt open-source software is presented. Using the built model, antenna deployment simulations are carried out for different cases, which differ in the forces used for the deployment. Values of deployment time, variations of angles between the V-folded bars, and tensions in the diagonal rods of the antenna sections during the antenna deployment are obtained.

The approach proposed in the article can be implemented using free software, ensures flexibility of modeling, and reduces the model development time.

Keywords: *reflector antenna, deployment, multibody dynamics, open-source software, flexible beam, joint.*

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