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MODELING CABLE-PULLEY DEPLOYMENT SYSTEMS OF TRANSFORMABLE ROD STRUCTURES

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The aim of this article is to develop a simplified method for modeling cable-pulley deployment systems of rod structures based on the calculation of cable tensions and nodal driving forces with account for friction and other features of the system.

Methods of theoretical mechanics, multibody dynamics, numerical integration of differential equations, and computer modeling were used during the research.

The task of developing a simplified approach to modeling cable-pulley deployment systems for rod structures is considered. It is proposed to determine nodal driving forces by calculating cable tensions with account for friction and other features of the cable-pulley system, cables, and pulleys.

To develop a model of cable-pulley deployment system, a rod system was chosen as the research object, which represents two sections of the transformable support truss of a reflector. Each section consists of diagonal and horizontal rods with tubular cross-sections. The sections are interconnected by hinge units. The structure is deployed using an upper and a lower cable, which pass through pulleys and are tensioned by an electric motor. The deploying forces are implemented by transferring the cable tension forces to the structure due to static friction and pressure between the cables and the pulleys. For further implementation of the model in an open-source software package, some simplifications were made due to the complexity of the design.

A simplified method was developed for nodal driving force calculation in simulating rod structure deployment with the help of cables. The tensions, elongations, slacks, and neutral length of the cables and the forces transmitted from the cables to the pulleys were calculated as a function of time. Using them, the deployment of a rod structure was simulated for a constant cable speed. The results make it possible to control the rod system deployment time and rate depending on the characteristics and tension forces of the cables.

The proposed approach is implemented using open-source software, and it provides modeling flexibility and reduces the model development and run time.

Keywords: *cable-pulley deployment system, transformable structures, multibody dynamics, open-source software, flexible rod.*

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