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PROGRAM CONTROL OF THE RETRIEVAL OF A SPACE TETHERED SYSTEM WITH THE RECOVERY OF ITS ORIGINAL VERTICAL ORIENTATION*Space Research Institute**of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine
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This study is concerned with a space tethered system of two bodies connected with an elastic massless tether. The aim of this study is to extend a new program control construction method for the deployment of space tethered systems in the orbit plane with their alignment along the local vertical at the deployment end to tether retrieval with specific terminal conditions. This allows one to programmatically control the tether length or tension in such a way as to provide the required change of the angular momentum of the tethered system under the action of the gravitational moment. The novelty also lies in a new approach to constructing control of underactuated mechanical systems, in which the number of control channels is less than the number of degrees of freedom. Here, it is proposed to impose a pitch constraint on the motion of the system, which will reduce the number of degrees of freedom, thus allowing one to implement a specified motion regime by controlling the system only in the remaining degrees of freedom. The character of the constraint imposed on the admissible time variation of the pitch angle is governed by the requirements placed upon the motion regime to be executed. This paper considers the retrieval of a tethered system initially aligned along the local vertical to a specified length. The tethered system must be aligned again along the local vertical, and its longitudinal oscillations must be absent. Accounting for all the requirements for the retrieval regime, it is possible to construct an admissible law of time variation of the pitch angle described by an eighth-order power series. For a tethered system with specified parameter values, a numerical study was conducted into the effect of the retrieval duration and the law of time variation of the pitch angle on the length of the retrieved tethered system and its behavior in the course of the retrieval. To demonstrate the practical simplicity of the proposed approach, a numerical example is given where tether retrieval is simulated numerically by integrating a Cauchy problem for Hill–Clohessy–Wiltshire equations. The analysis of results is illustrated by graphs. At the beginning of the paper, the state of the art in the problem under consideration is overviewed.

Keywords: *tethered system, retrieval, control, length variation, vertical position, deformation, space tethered system.*

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