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EXPERIMENTAL DEVELOPMENT FOR ELEMENTS OF ROTATING SPACE TETHER SYSTEM  
FOR LARGE DEBRIS REMOVAL

**Abstract**

The development of a space complex for de-orbiting of large space debris objects requires conducting ground-based and orbital experiments to test the key components of the complex. The proposed work considers the problem of developing technologies for gripping and de-orbiting space debris objects (hereinafter referred to as the target) using rotating space tether system (RSTS) [1,2]. RSTS involves the use of the space complex consisting of a launch vehicle, space tug (ST) and autonomous docking module (ADM) separated from the ST on the tether to intercept the target. The structure of the orbital complex allows delegating complex tasks (target detection, rendezvous, and gripping) to the ADM, to simplify the adaptation of the existing upper stages for use as a ST, so the “off-the-shelf” upper stages like “Frigate”, “Breeze” could be used as a ST. There are two ground-based experimental test-beds are proposed. The first one for testing the deployment process of RSTS after the separation of the ADM from the ST, and for testing the control of the tether length after capturing the target by the ADM for damping the tether’s oscillations. The test-bed utilizes the tether system with the tension controlled by an electric drive to simulate the dynamic properties of the RSTS. The second setup is designed to test the target capture process using the net for different initial kinematic parameters of the target. The setup includes the net ejection device, and target mock-up. The scheme of the orbital experiment is also proposed. The experiment supposes forming the space tether system “ST – tether 1 – ADM – tether 2 – net – target”, capturing the target using ADM, forming and deorbiting of the RSTS. Two methods of capturing are considered: using a manipulator, probe-cone type device, and net. Two options for the structure of the orbital complex are proposed in terms of the target type: a) utilizing a mock-up as the target; b) using existing debris object (for example, Kosmos-3M upper stage). The proposed experiment could be carried out as a piggyback mission [2]. References [1] V. I. Trushlyakov, V. V. Yuditsev “Rotary Space Tether System for Active Debris Removal,” *Journal of Guidance, Control, and Dynamics*. Vol. 43, No. 2, February 2020. doi: <https://doi.org/10.2514/1.G004615>. [2] V. I. Trushlyakov, V. V. Yuditsev A method for conducting flight tests of autonomous docking module for cleaning the orbit of space debris / Patent 2643020 RU B64G 1/64. Issued 29.01.2018.