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CONTROL SCHEME OF TETHER DRAG DEORBIT SYSTEM IN ORBITAL PLANE

Abstract

The tether drag deorbit technology with chemical or solar electric propulsion has broad application prospects in the disposal of abandoned satellite, the orbital rescue of spacecrafts, and the transportation of space supplies. Compared with the traditional applications of tethered satellites, the compelling active force on the tether drag deorbit system is not distributed but centralized; moreover, the magnitude of the chemical propulsion is much greater than electric propulsion or disturbing forces, and the direction can be arbitrarily adjusted. Hence, the research on control scheme of tether drag deorbit system has an important theoretical and practical significance. In this paper, based on a dumbbell model of tethered satellite, a tension control scheme and a thrust control scheme of tether drag deorbit system in orbital plane are respectively proposed. In the tension control scheme, the tether tension can be measured by tension sensor and controlled by adjusting the tether length with a certain windlass mechanism, so that the librational angles could track the expected value; meanwhile, the tether could come back to the initial value. Because of the windlass mechanism, the slackness of tether can be avoided. In the thrust control scheme, the tether drag deorbit system is with a short tether in orbital maneuvering and the thrust acceleration imposed on the base satellite can be adjusted to avoid the slackness of tether and damp out the librational angles; besides, it is required that the regulation value of thrust acceleration meets with accuracy trajectory in practical engineering. Afterwards, a reasonable deorbit case of an abandoned GEO satellite is studied, in which the control of base satellite is considered; then, the advantages and disadvantages of two control schemes are analyzed and an improved control method is given. Numerical simulation results indicate that the slackness of tether can be eliminated and the librational angles are damped out according to the designed controllers, and the stability of the attitude of abandoned satellite is also guaranteed during flight. The proposed control schemes are feasible, which is useful for the flight safety. This study provides a reference for research on tether drag deorbit technology.