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EXPLORATION OF THE FUTURE APPLICATION MODE OF LASER PROPULSION FOR THE SPACE DEBRIS REMOVAL

Abstract

Many countries have begun to focus on the technology of laser for space debris removal because of the significant advantages of laser removal of space debris such as non-contact, permanent removal, long operating distance, repeatable work and low cost.From the interaction mechanism of laser and substance and the international current development trend, we can see that there are mainly two ways for laser to remove space debris: ablation loss and laser propulsion derailment. Laser removal method of space debris based on energy ablation has high requirements on laser power, beam quality and other performance, which would result in large load weight, the use of harsh environment, and then bring amazing launch and carrying costs. The laser propulsion derailment is costly and time-consuming because of the ultra-small thrust produced by one laser at current state. Therefore, this paper presents a group of laser propulsion sub-platforms which can be discrete, coordinated and networked, and also can effectively remove small fragments. Specific programs include: 10 to 20 discrete, coordinated and networked miniature sub-platforms are installed on the basic platform which could be space station or spacecraft or large satellite. One sub-platform is equipped with a high peak power laser, a high-speed discharge power supply, a collaborative communication module and so on. Platforms can transform and improve the laser beam combination and control technology of "laser ignition device", and laser(peak power higher than 10kW) can be emitted to small debris at the same time, achieve the accumulation of laser propulsion force, and thus effectively promote debris off track. After the completion of pushing small pieces off orbit, the sub-platforms will fly back to the basic platform to complete the preparatory work (e.x. charging, filling) and wait for the next debris removal task. This application mode can solve problems: 1) It is difficult to push small fragments away from the orbit effectively just with single laser beam propulsion, and the combination of multi-beam laser can effectively improve thrust. 2) The cost of changing orbit of large platform to each nearby debris is too high, however the cost of the sub-platform close to small fragment is much smaller, and short distance also can significantly reduce the requirements to laser. This

application mode involves core and new technologies: 1) ultra-small, high peak power laser production; 2) lots of small platforms space network, collaboration and control; 3) high-peak power multi-beam laser combination and control.