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SPACE PROPULSION SYMPOSIUM (C4)
Space Propulsion (8)

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THRUST CONTROL SYSTEM FOR MAGNETIC SAIL SPACECRAFT UNDER VARIABLE SOLAR WIND ENVIRONMENT

Abstract

Deep space exploration using existing propulsion systems, such as chemical propulsion and electric propulsion, spends huge amount of fuel and takes long term. Therefore, we need more efficient and high power propulsion system to explore deep space. Magnetic sail is one of such promising propulsion systems. The magnetic sail is subjected to thrust force by solar wind momentum with the artificial magnetic fields from the superconductive coil. The superconductive coil is excited to maintain the magnetic field around the spacecraft. Although solar wind changes variously, we must regulate current through the superconductive coil to control the thrust force. Thus, we need a power supply and current regulation system on the spacecraft. The system for power supply with little ripple current and current regulation with mild changes in output is usually used for the superconductive coil. Superconductive state is sensitive to variation of inductive voltage, current, magnetic field, and temperature in the coil. The ripple current and drastic changes of these parameters locally bring about transition to normal conductivity, burn and break the superconductive coil. However, we cannot utilize the low ripple system with mild change in the output for typical superconductive system since it is too heavy to mount in the magnetic sail. For example, the bipolar power supply, which has rippled component of around 5 ppm and are rated at 10 V and 200A, is usually used. The bipolar power supply approximately weighs 200 kg and is inappropriate for the magnetic sail which weighs 1000 kg. Therefore, we need to design a new lightweight system for the magnetic sail which does not deteriorate the superconductivity state. We investigate effects of the ripple component and drastic change in the output at the current regulation to the superconductive state . We propose the new lightweight power supply and current regulation system feasible in the superconductive coil for the magnetic sail.