Novel Space Environment Monitor, Instrument, and Space Mission Concepts

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Lorentz Force Spacecraft Formation Dynamics

Dynamics and control aspects of a charged satellite using the Lorentz force were investigated. The concept of the Lorentz-augmented charged satellite realizes propellant-less electromagnetic propulsion, using the interaction between an electro-statically charged satellite and the Earth's magnetic field. Charging of satellites can be controlled by devices like ion or electron gun. The devices are smaller and lighter than conventional chemical thrusters and suitable to be carried by small-size satellites. We investigated relative dynamics of two satellites orbiting around the Earth. One is a non-charged satellite called a target satellite, and the other is a charged satellite located near the target satellite on a circular orbit. We studied the effect of the Lorentz force on the relative motion of the chaser satellite with respect to the target satellite on an elliptic orbit or on a circular orbit as a special case.

Magneto-Plasma Sail (MPS) Space Propulsion System

An MPS (Magneto-Plasma Sail) is a unique propulsion system, which travels through interplanetary space by capturing the energy of the solar wind, which inflates a weak original magnetic field made by a super-conducting coil of about 2-10 m in diameter with an assistance of a high-density plasma jet. From our theoretical estimations, momentum transfer from the solar wind to a spacecraft with a coil is large enough if the plasma source is operated to inflate only the magnetic field away from the spacecraft. Our activities in 2006 are as follows: (a) Sizing (mass, dimension, current, etc.) of the super-conducting coil to produce magnetic field around the spacecraft, (b) Preparation of the experiment facility to measure magnetic field, temperature, current etc. around super-conducting coil.

Monitor system for Space Electromagnetic Environments (MSEE)

The main objective of the MSEE (Monitor system for Space Electromagnetic Environments) is to monitor the electromagnetic disturbances caused by human activities in space. It consists of the small sensor units distributed around the target space. Our main activities on the development of the MSEE in 2006 are as follows: (a) Development of the analogue ASIC containing the differential amplifiers and A/D converters, (b) Simulation study on the location estimation method for each sensor unit.

Wave-Particle Interaction Analyzer(WPIA) Instrument for Spacecraft Observation.

For a practical application of a plasma wave instrument, a direct measurement system of wave-particle interactions is one of the important systems to the space science mission. WPIA instrument can observe wave-particle interactions by calculation of the cross correlation functions between obtained waveforms and detected particles onboard. Our designed system is assembled in one FPGA (Field Programmable Gate Array) IC and data calibration and correlation method is programmed in FPGA.