論 文 の 内 容 の 要 旨

論文題目　Coupled Orbit-Attitude Dynamics of Spacecraft around Small Celestial Bodies（小天体近傍における宇宙機の軌道−姿勢カップリング運動）

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The motion of a spacecraft in the proximity of a small body is significantly perturbed due to its irregular gravity field and solar radiation pressure. Moreover, in such a strongly perturbed environment, the coupling effect of the orbital and attitude motions exerts a large influence that cannot be neglected. Because of the perturbations and the coupling effect, the orbital and attitude motions of spacecraft around small bodies are strongly disturbed. This environment leads to the frequent use of attitude and orbit control systems in spacecraft operation. To circumvent this problem, this thesis proposes two different approaches: the implementation of naturally stable orbit-attitude coupled motion and electrostatic flight using the electric field naturally formed around a small body.

The former strategy is achieved by investigating natural coupled motion that involves both a Sun-synchronous orbit and Sun-tracking attitude motion. This orbit-attitude coupled motion enables a spacecraft to maintain its orbital geometry and attitude state with respect to the Sun. Therefore, the proposed method can reduce the use of an orbit and attitude control systems. On the other hand, the electrostatic flight is accomplished by using a spacecraft with electrically charged appendages that actively induce electrostatic force via an ambient electrostatic field to control its motion. Electrostatic flight offers flexibility in spacecraft operation near small bodies. Neither method requires any fuel, so they can be useful for small-body missions. This thesis provides general theories and simulation results for natural orbit-attitude coupled dynamics and electrostatic flight around small bodies. Consequently, it is demonstrated that the presented method exhibits intriguing and valuable dynamical characteristics.