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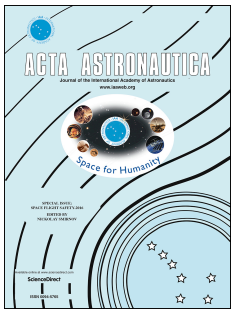

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Shota Kikuchi, Kathleen C. Howell, Yuichi Tsuda, Jun'ichiro Kawaguchi

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Orbit-Attitude Coupled Motion around Small Bodies: Sun-Synchronous Orbits with Sun-Tracking Attitude Motion

Shota Kikuchi[a,*], Kathleen C. Howell[b], Yuichi Tsuda[c], Jun'ichiro Kawaguchi[c]

[a] *Department of Aeronautics and Astronautics, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, Japan*
[b] *School of Aeronautics and Astronautics, Purdue University, 701 West Stadium Avenue, West Lafayette, IN, USA*
[c] *Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (JAXA), 3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa, Japan*

Abstract

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. In such a strongly perturbed environment, the coupling effect of the orbital and attitude motions exerts a large influence that cannot be neglected. However, natural orbit-attitude coupled dynamics around small bodies that are stationary in both orbital and attitude motions have yet to be observed. The present study therefore investigates 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 without requiring active control. Therefore, the proposed method can reduce the use of an orbit and attitude control system. This paper first presents analytical conditions to achieve Sun-synchronous orbits and Sun-tracking attitude motion. These analytical solutions are then numerically propagated based on non-linear coupled orbit-attitude equations of motion. Consequently, the possibility of implementing Sun-synchronous orbits

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*Corresponding author
Email addresses: kikuchi.shota@ac.jaxa.jp (Shota Kikuchi)

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