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Author: Dr. Takahiro Kato
Kyushu University, Germany, kato.takahiro@dlr.de

Prof. Jozef C. van der Ha
Kyushu University, Japan, jvdha@aero.kyushu-u.ac.jp

# ORBIT ACQUISITION AND STATION-KEEPING IN SUN-SYNCHRONOUS ORBIT USING SOLAR RADIATION PRESSURE

**Abstract**

Solar radiation pressure has been studied for many years, and is already utilized by large satellites in GEO for attitude stabilization. On the other hand, solar sailing has attracted a number of missions because of its efficiencies in mass, fuel consumption, and cost. This paper introduces a practical and low-cost method of orbit acquisition and station-keeping in Sun-Synchronous Orbit (SSO) by using solar radiation pressure. The proposed method uses a fixed solar sail on the satellite to utilize the solar radiation pressure over the orbit. The solar radiation pressure has a vast available range, which suggests a wide variety of application, regardless of the size and mission of the satellite. For the sake of avoiding complexity and reducing cost, we employ a standardized small satellite bus (QSAT) concept which is being developed in Kyushu University. Recently, small satellites have grown to be adequate test beds for technological challenges even by universities because of the short development period and low cost. Therefore, this study aims to implement the concept of solar sailing for small satellites in SSO. Because the angle between the sun vector and the orbit normal remains fixed in SSO, and is defined by the right ascension of the ascending node of the orbit. Thus, by introducing several assumptions, we can analytically predict the effect on semi-major axis, eccentricity, and other orbital elements. As the solar radiation is a general propulsion source, the proposed method can be applied in various missions. In this study, we propose an implementation for a space weather observation mission with a series of small satellites in a constellation in SSO. Inserting several (for instance, 6) satellites into the same SSO by one launcher as a first stage of the constellation and spacing each satellite by controlling the attitude. Assuming that one of the body-axis is fixed parallel to the orbit normal and keeping the surface of the solar sail fixed to the satellite body, the in-plane component of the solar radiation force can be controlled by changing only the attitude pitch angle. The control parameter is the orientation angle of the satellite with respect to the sun vector. Each satellite is controlled in order to maintain a uniformly-distributed constellation in terms of true anomaly. This paper focuses on the strategy of orbit acquisition and station-keeping after the orbit insertion. The analytical model and the results of the simulations will be presented in the paper.