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MONITORING THE HEALTH OF GEOSYNCHRONOUS SPACECRAFT USING PHOTOMETRIC OBSERVATIONS

Abstract

Space debris is no longer a used artifact that exists in space.In recent years, space environmental pollution by space debris is getting worse and the risk of collision with space debris is increasing. In the Geostationary region (GEO), there are many communications or meteorological spacecraft. Therefore, geosynchronous spacecraft sometimes take the avoidance of collision with space debris. If a spacecraft collides with an object, then it may be damaged such as break of the solar paddles. To be aware of the space debris environment or to avoid accidental collision between an operational spacecraft and a piece of debris, space objects are being tracked by optical sensors. It is important to observe the dynamics of space objects or their shapes for checking up the operational states of spacecraft or removing large debris in the future. Nowadays, the health a spacecraft is monitored by telemetry data received. That is to say, we can not get the information about the shape although the satellite may collide and break. This paper proposes a method of estimating the attitude motion and the shape of space objects by using data from radar and optical sensors on the ground to check up the operational states of three-axis stabilized geosynchronous spacecraft in a complex form. The spacecraft model has a pair of solar paddles and three antennas. Because of this complicated shape, considering self-shadowing effect is essential for calculating orbit perturbations and light intensity. Using various kinds of states of the three-axis geosynchronous spacecraft, the change in brightness or light intensity of the target, called light curve, is simulated considering with self-shadowing effect. This paper evaluates the differences in light curve, resulting from the difference in health status of the target. Health status is, for example, that solar paddles properly face the sun or that the antenna points toward the earth. This paper also employs an unscented Kalman filter to estimate rotational and translational states of three-axis geosynchronous spacecraft and least squares method to estimate the shape of object. The result of this strategy is presented in this paper.