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MEASURING THE VARIATION IN THE ORIENTATION OF A SOLID PLANETARY BODY USING LIDAR VIA SATELLITE

Abstract

Seasons on planetary body exist because of its axial tilt with respect to its orbital plane around the sun/star. Variation in the axial tilt will have direct implication on the season of the planetary body. For e.g. Axial tilt of Mars varies from 0 to 60 due to which it experiences extreme climatic conditions. Axial tilt of Earth is more stable than that of Mars as Earth is stabilised by its bigger moon in comparison to two very small moons of Mars. Still, the axial tilt of earth is not entirely stable because of chandler wobble. Measurement of variation in axial tilt of Earth is already performed by using in-ring laser, which is underground and requires highly advanced facilities. It is also measured by an array of radio telescopes. On Earth, we can build these facilities but on different planetary bodies it would be very difficult to use these highly complicated setup and hence measurement of it with minimal equipments is preferred. The solution to this problem is based on LIDAR principle, a method that measures distance to a target by illuminating the target with laser light and measuring reflected light with a sensor. Differences in laser return time can be used to measure the distances. A satellite, equipped with a laser and a sensor, will be orbiting the planetary body of which variation in the tilt we want to measure. On surface of planetary body there will be mirror which is placed with the help of a rover. Mirror, is of the shape of circular steps of suitable width; with it seismometer will be present which will eliminate the errors caused by ground vibrations. Initially, the laser will be pointing at centre. But as the axial tilt changes, the laser will point to a step which is at a different height from centre resulting in different return time from that obtained from centre which gives distance of that step from centre, thus variation in the tilt is determined. This method can help us measure the variation in the axial tilt of any planetary body with minimal equipments and can help us determine its geological history as well as its future conditions from which we can decide further exploration of that planet. All the parameters, mirror design specifications and technology requirements will be presented with supporting calculation and data.