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NOVEL LOW-COST LIGHTWEIGHT LASER RETROREFLECTORS FOR A SUSTAINABLE NEW-SPACE ERA

Abstract

Satellite laser ranging (SLR) provides the most accurate orbit determination information for satellites and space debris. Laser ranging accuracy and availability is greatly increased if the target object hosts a laser retroreflector (RR), even though ranging is possible without RRs. The majority of satellites today do not include RRs in their designs, although satellites that do host RRs can easily gain precise orbit information. The accessibility of SLR data and the associated cost and mass penalties are cited as some of the key reasons satellite manufacturers are currently passing up on their use.

Therefore at Lumi Space we have been undertaking a number of research development projects to fully understand user needs, assess the market segmentations, turn user needs into product requirements, and perform optical and optomechanical design iterations. Utilising rapid prototyping, we have manufactured a range of models initially in polymer, then in a variety of metals for different applications. Material selected was carefully approached to suit the vacuum and radiation environment. We have performed a range of optical tests to ensure product quality and to characterize performance. Also, vibration testing for a range of possible launch loads for the most popular launch vehicles have been conducted to guarantee the integrity of the bonded parts, and finally thermal cycling has been performed to verify that the designs are appropriate for the space environment in a range of different orbital/thermal conditions.

This paper presents several new RR solutions for different mission profiles and user needs. Updates are given on their design status, prototype testing, and performance specifications. The first solution presented is a fresh look at a traditional approach using glass corner cubes, however these RRs are lower in cost and mass than those currently available and so an attractive option for small satellites looking to take advantage of precision space situational awareness. The second is a novel ultra-lightweight retroreflective sheeting suitable for use on Cubesats. Finally, a new active device ("licence plates in space") is being developed and tested to enable accurate object identification alongside satellite health and status determination remotely.

These developments alongside the advent of commercial SLR signals a new frontier in precision space situational awareness. This is a necessary step in enabling a large number of satellites to coexist safely.