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SATELLITES REFLECTANCE AND BRIGHTNESS TESTING FACILITY FOR REDUCING SPACECRAFT CONSTELLATIONS LIGHT POLLUTION

Abstract

In the latest years a great quantity of satellites constellations have been designed for LEO orbit. The satellite design of some of these clusters and constellations had issues in presenting an excessive brightness. This feature can greatly affect the astronomical observations from ground, creating streaks over the astronomical pictures and making satellites a source of ineliminable noise for the scientific data. As an example, mitigation actions to be performed after launch imply enormous costs and significant delays in development programmes. For this reason, it is necessary to develop a ground-based method to examine the satellite brightness before launch, to diminish the impact on astronomy and to allow for sufficient time for the mitigation actions. The Sapienza Space Systems and Space Surveillance Laboratory (S5Lab) research team at Sapienza University of Rome is currently developing a facility to test satellites' optical properties. The system consists in a high-power LED light source and radiometric probes, operated by a robotic arm. The aim is to reproduce all the Sun-object-observer relative angular configurations, by analyzing the object reflectance on all the phase angles and by applying photometric analyses on the acquired data. This allows to create a reflectance model in order to determine the impact of the object on astronomy observations together with its actual brightness when in-orbit. The validation process of the simulation is being carried out by using different small-size models of in-orbit satellites and even optical characterization models of nano-satellites developed at S5Lab. The results obtained with the testing facility are compared to real photometry data from the S5Lab optical observatories to verify the methodology and to prove the validity of this study. This paper will deal with the characterization of the ground-based facility with the aim to study satellites' optical properties before launch. After a first analysis of the obtained data, a general method to test the brightness will be provided. This type of application will be relevant for the next constellations launches and to preserve the night sky and the astronomical research. At the end of the paper, the main achievements and results will be described, together with some guidelines for minimizing the brightness and reflectance of common form factors.