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Author: Mr. Pascal Sauer
TU Darmstadt, Germany, pascal.sauer@tudsat.space

Dr. Georg Kirchner
Austrian Academy of Sciences, Austria, Georg.Kirchner@oeaw.ac.at
Mr. Martin Michel
TU Darmstadt, Germany, martin.michel89@gmail.com
Ms. Vanessa Neumann
TU Darmstadt, Germany, vanessa.neumann@tudsat.space
Mr. Hanjo Schnellbächer
TU Darmstadt, Germany, Hanjo.schnellbaecher@tudsat.space
Mr. Nicholas Wolf
TU Darmstadt, Germany, nicholas.wolf@tudsat.space
Mr. Christoph Weber
TU Darmstadt, Germany, christoph.weber@physik.tu-darmstadt.de
Mr. Dominik Auth
TU Darmstadt, Germany, dominik.auth@physik.tu-darmstadt.de
Dr. Stefan Breuer
TU Darmstadt, Germany, Stefan.breuer@physik.tu-darmstadt.de

EXAMINING RETRO-REFLECTIVE FOILS FOR USE IN SMALLSAT APPLICATIONS AND SPACE DEBRIS LASER RANGING

Abstract

Satellite Laser Ranging (SLR) is a proven technique for high-precision distance and position measurements of satellites equipped with retro-reflectors. Satellites orbiting in low earth orbits of a few 100 kilometres up to geostationary orbits are tracked by more than 40 SLR stations across the globe. These are coordinated by the International Laser Ranging Service (ILRS) network. Recent ambitions in SLR aimed at tracking ever-smaller satellites like CubeSats as well as non-cooperative targets including space debris formed by used upper stages. However, due to diffuse-only reflection of such uncooperative targets, SLR-stations require more powerful laser sources. The amount of SLR stations with such lasers are very limited. Here, we suggest the application of commercially available retro-reflective foils for potential future application on satellites and rocket upper stages. These thin foils contain micro-structured retro-reflectors and are flexible, ultra-light weight and low-cost commercial off-the-shelf products. We experimentally study the spatially-resolved reflection characteristics of retro-reflective foils and compare their backreflection efficiency with commercially available retro-reflectors prisms, in a laboratory and field testing environment. Our results suggest that retro-reflective foils bear the attractive potential of easy implementation, as well as cost- and weight-efficiency allowing for laser tracking and precise orbit determination of space debris targets, as well as nano-satellites equipped with such retro-reflective foils, by standard SLR stations. Subsequently to the validation of the efficacy of the foils in a laboratory, an in orbit technology demonstration is intended to be conducted on a CubeSat developed by the student group TUDSaT.