16th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space Debris Detection, Tracking and Characterization (1)

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CHARACTERISATION OF SPACE DEBRIS THROUGH THE ANALYSIS OF ON-SKY POLARIMETRIC SIGNATURES OBTAINED WITH A MICROPOLARISER ARRAY IMAGE SENSOR

Abstract

Polarimetric imaging is a useful technique to infer geometry changes and to classify materials in an illuminated resident space object. Object material and geometry show different degrees of polarisation depending on the specular and diffuse characteristics at surface microstructure level and on their relative material composition. In an effort to better characterize space debris, we measure the passive polarization signatures of the reflected sunlight coming from these objects with an amateur class telescope, and analyse the polarisation components in their unresolved images. There are some studies about this topic aided with computer simulations and controlled experiments in laboratory, where different spacecraft materials have been tested. Their results show that different polarimetric signatures are obtained depending on the type of material and the incident light angle. The present work intends to address the dearth of polarimetric on-sky observations of space debris with ground telescopes, to relate these observations with existing simulations and laboratory experiments, and to compare them with previous on-sky observations. In our current setup we use a 0.3 metre aperture, Meade LX200 GPS telescope, and a micropolariser array camera from 4D Technology, which can acquire simultaneously four polarisation angles with just one image sensor. The sensor image is defocused on purpose to obtain sufficient pixels with polarimetric information for each of the polarisation angles. In order to maximise the accuracy of the polarimetric signatures, science images are calibrated with flat field correction to compensate for optical path aberrations in the setup, and corrected with dark and bias frames to minimise different types of noise inherent to the image sensor. In order to obtain a sensible time resolution, a set of relatively bright rocket bodies in a high LEO orbit has been selected as the targets to study, launched in different years, formed by different materials, and with different tumbling rates. We compare the obtained polarimetric signatures with other author observations and analysis, and with our previous research, where with a small set of LEO rocket bodies and GEO satellites, the results show a relationship between the launch date of the spacecraft and its degree of linear polarisation. Now we are extending this research with a more complete set of objects and observations to confirm this end, and to relate these observations to their geometry and types of materials.