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Space Debris Detection, Tracking and Characterization - SST (1)

Author: Mr. Gaetano Zarcone
Sapienza University of Rome, Italy, tanozar90@gmail.com

Mr. Lorenzo Mariani
Sapienza University of Rome, Italy, mariani_lorenzo@hotmail.it

Mr. Federico Curianò
Sapienza University of Rome, Italy, fcuriano@gmail.com

Mr. Shariar Hadji Hossein
Sapienza University of Rome, Italy, shariar.hadjihossein@gmail.com

Mr. Lorenzo Cimino
Sapienza University of Rome, Italy, cimino.1785896@studenti.uniroma1.it

Mr. Matteo Rossetti
University of Rome "La Sapienza", Italy, rossetti.1821458@studenti.uniroma1.it

Ms. Mascia Bucciarelli
University of Rome "La Sapienza", Italy, bucciarelli.1792406@studenti.uniroma1.it

Mr. Luigi di Palo
Sapienza University of Rome, Italy, lui.dipalo@gmail.com

Ms. paola celesti
Sapienza University of Rome, Italy, paola.celesti93@gmail.com

Mr. Lorenzo Frezza
Sapienza University of Rome, Italy, lorenzo.frezza@uniroma1.it

INNOVATIVE OBSERVATION SYSTEMS FOR LEO AND GEO ORBITING OBJECTS STATE
DETERMINATION

Abstract

The continuously increase in number of satellites launched, makes that the Space Traffic Management (STM) activities became a primary issue in the aerospace field. Even if the Low Earth Orbit (LEO) remain the most congested orbital regime, also the Geostationary orbit (GEO) begins to get crowded due to the alarming increase of space debris population. Several years of experience in the Space Situational Awareness (SSA) and Space Surveillance and Tracking (SST) framework characterize the Sapienza Space Surveillance and Space Systems Laboratory (S5Lab) research team. The space object observation is mostly based on Charge Coupled Device (CCD) technology pursuing the sidereal tracking observation strategy. This technology, however, doesn't allow to obtain the measurements necessary to retrieve the so-called characterization information includes details about the attitude motion, shape and material of the space object. For LEO objects, a bistatic optical observations systems has been set up: REmote Space Debris Observation System (RESDOS) and Sapienza Coupled University Debris Observatory (SCUDO), thanks to last generation of scientific Complementary Metal-Oxide Semiconductor (sCMOS) sensors, permit to obtain a large number of synchronized measurements. These hardware are able to track the object during its passage above the observatory and allow to record the brightness variation over time, i.e., light-curves, of the objects itself useful for the attitude determination. For GEO ring monitoring, the fields of view (FoV) obtained with the system for LEO observation are too small. The large field of view requested, most of all in right ascension (RA) direction, has been satisfied with the SURveillance GEOstationary

(SURGE) system. A digital cameras system, able to cover up to 120 in Ra, have been developed so that each camera points in a different area of sky vault focusing on the GEO ring. Since no moving parts are foreseen, the FoV of SURGE is fixed in sky vault. Its easy of transport, and its low cost makes SURGE a suitable system for the GEO ring surveillance. All these observation systems, which exploit different observation strategies, allow to obtain a huge amount of data for all the target objects retrieved thanks to fast imaging system. The continuous and fast increasing of satellite number makes that these advanced and innovative systems are required for the SSA and SST purposes. In this paper the development of these systems, the algorithms useful to process the obtained data, and the results of LEO and GEO objects observations will be shown.