Apparent colours as manufacturing markers for GEO satellites

Alessandra Di Cecco[1], Alberto Buzzoni[2], Maddalena Mochi[3], Giuseppe Altavilla[4,5], Sara Brambilla[6], Marco Castronuovo[1], Fiore De Luise[7], Silvia Galleti[2], José Guichard[8], Cosimo Marzo[1], Gaetano Valentini[7]

(1) ASI, Italian Space Agency, via del Politecnico snc, Rome, IT
(2) INAF-OAS, via Gobetti 93/3, Bologna, IT
(3) Università degli Studi di Pisa, Largo Pontecorvo, Pisa, IT
(4) SDC-ASI, via del Politecnico snc, Rome, IT
(5) INAF-OAR, Via Frascati 33, Monte Porzio Catone (RM), IT
(6) Aero Club Monte Comizzolo, Via San Miro 10, Suello (LC), IT
(7) INAF-OAAB, via Mentore Maggini snc, Teramo, IT
(8) INAOE, L.E. Erro 1, Tonantzintla, Puebla, 72840 (México)

Introduction

Space debris pose a significant risk for operational satellites, astronauts and new launches, as well as hazard linked to uncontrolled re-entry in the Earth's atmosphere.
The observational and tracking activities of space debris are currently on-going worldwide. Among different techniques used to characterize these objects, multi-band photometry is a powerful tool to investigate their physical parameters (surface materials, shape, etc).
We present the analysis of photometric data of 23 geostationary satellites, acquired using three optical telescopes; two telescopes are located in Italy (belonging to the National Istitute for Astrophysics, INAF) and one in Cananea, Mexico (INAOE).

Observational strategy

- The telescopes are equipped with Johnson – Cousins filter sets,
- 30 to 60 frames per object, alternating the filter sequence,
- 60 sec exposure time,
- Acquired instrumental calibration frames and Landolt stellar fields for standard calibration.

Observation sites

- Cassini-Loiano Telescope
- Teramo Normale Telescope
- Guillermo Haro Astrophysical Observatory

Data analysis

Step 1. Lightcurve reconstruction

We reconstructed the lightcurves for each GEO satellite in our sample (**Fig.1**). Moreover, we reconstructed the color-lightcurves by calculating the difference between two consecutive frames, and we estimated the mean color-index as the average value of the color-lightcurve.

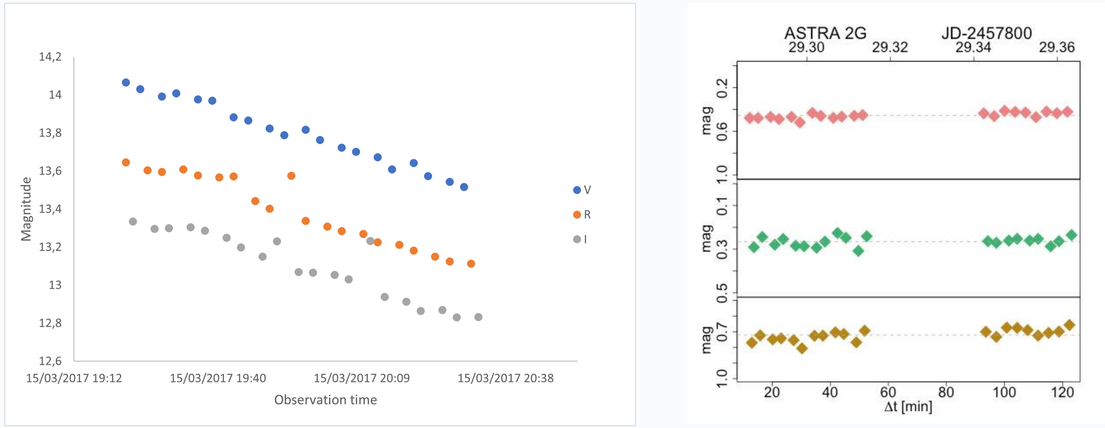

Fig. 1. Lightcurves (left) and color-lightcurves (right) obtained for the ASTRA 2F and ASTRA 2G GEO satellites.

Step 2. Color-color planes

The obtained values were investigated through color-color planes (**Fig. 2**), where a search for possible correlations with the structural features (retrieved from the web) of the bus and model of each satellite is underway.

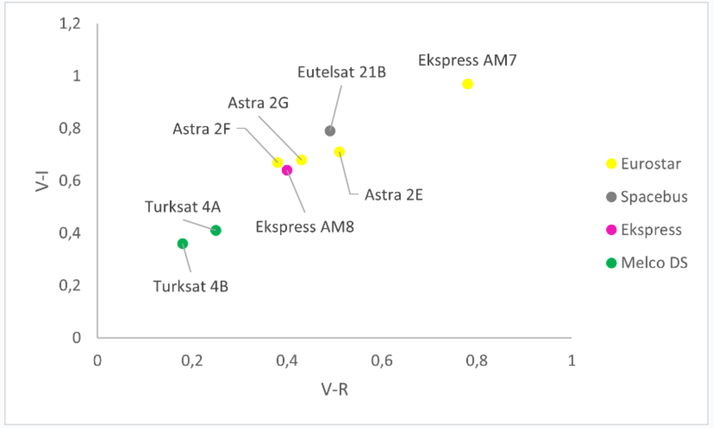

Fig. 2. Representation of a subset of our sample on the V-I vs V-R color color plane, tagged with the satellites' names and colored according to their bus families.

Name	Bus & Model	Launch date
Astra 2E	Eurostar 3000	30/09/13
Astra 2F	Eurostar 3000	28/09/12
Astra 2G	Eurostar 3000	27/12/14
Eutelsat 21B	Spacebus 4000C3	10/11/12
Ekspress AM7	Eurostar 3000	18/03/15
Ekspress AM8	Ekspress 1000NTB	14/09/15
Turksat 4A	Mitsubishi Melco DS-2000	14/02/14
Turksat 4B	Mitsubishi Melco DS-2000	16/10/15
Anik F1R	Eurostar 3000S	08/09/05
Anik F1	Hughes HS-702	21/11/00
Anik G1	Loral SSL-1300	15/04/13
Mexsat 3	GeoStar 2.4	19/12/12
Astra 1H	Hughes HS-601HP	18/06/99
Astra 1KR	Lockheed Martin A2100AXS	20/04/06
Astra 1L	Lockheed Martin A2100AXS	04/05/07
Astra 1M	Eurostar 3000	05/11/08
Hispasat 1C	Spacebus 3000B2	03/02/00
Hispasat 1D	Spacebus 3000B2	18/09/02
Spainsat	Loral SSL-1300	11/03/06
Eutelsat 13A	Spacebus 3000B3	21/08/02
Eutelsat 13B	Eurostar 3000	04/08/06
Eutelsat 13C	Eurostar 3000	20/12/08
Meteosat 8	Alcatel spin stabilized	28/08/02

Conclusions

- Hints of a possible correlation between some of the considered features (i.e. bus, model, etc.) and photometric colors (V-I, V-R).

References

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