

GUSDON

Global University Space Debris Observation Network

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SAPIENZA
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What is a space debris?

- Space debris is defined as all non-functional, human-made objects, including fragments and elements thereof, in Earth orbit or re-entering into Earth's atmosphere. Human-made space debris dominates over the natural meteoroid environment, except around millimetre sizes.

ESA website: http://www.esa.int/Our_Activities/Operations/Space_Debris/FAQ_Frequently_asked_questions

- They consist in: final rocket stages, fragments produced in collisions and explosions in orbit, dust originated from paint erosion, engines expelled material, etc.

What is their dimension?

- Estimated 700 000 objects larger than 1cm in diameter. More than 170 000 000 objects larger than 1 mm
- These objects are travelling at extremely high speed, up to **56 000 Km/h**

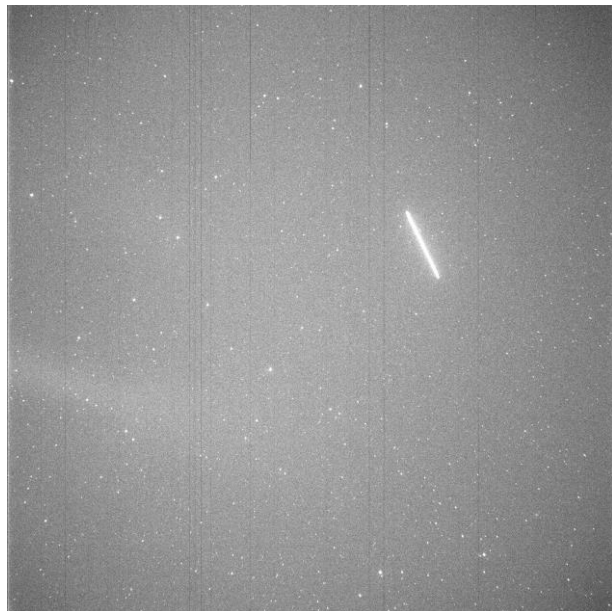




Space debris optical observations techniques

- Sidereal tracking
- Target tracking

SIDEREAL TRACKING: Tiangong1



TARGET TRACKING: two GEO satellites



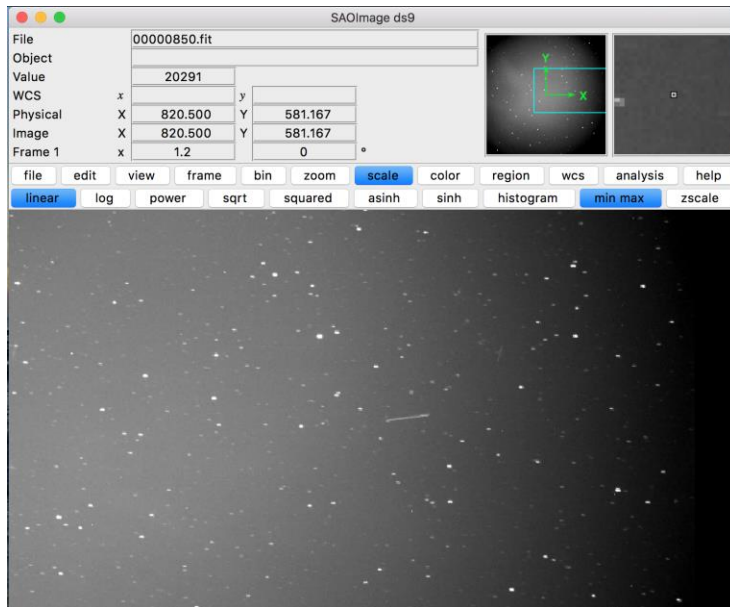
USA 155, Mistral 42 (7), 17 Aug 2015, 15:41:32 - 15:42:02 UT

Marco Langbroek, Ulsd, Bel. Canon EOS 7D-300 @ 70mm f4.0 @ ISO 2000

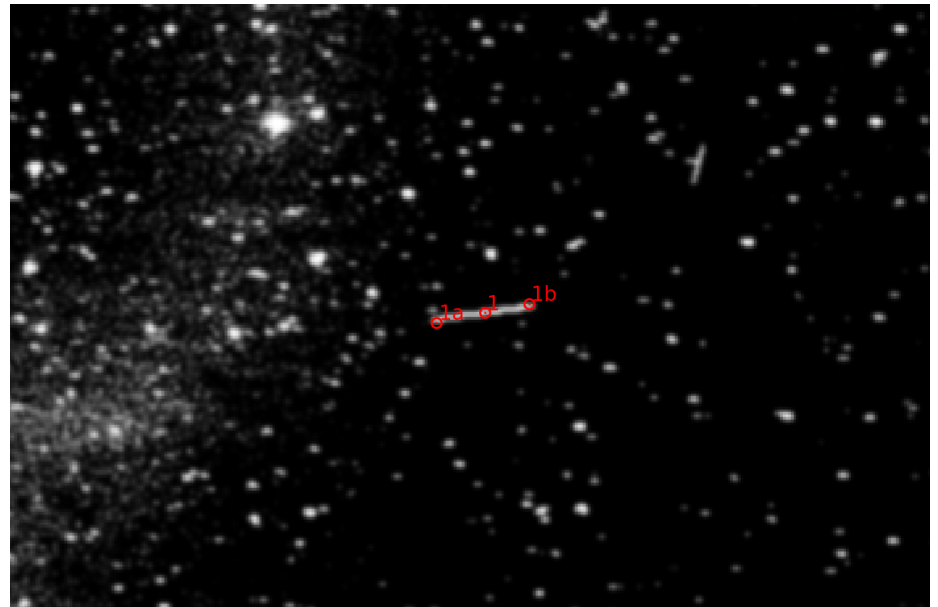


Sidereal Tracking - example

RAW IMAGE



PROCESSED IMAGE: with identified object



- Once the object has been identified the stellar field can be solved (astrometric solution) and its celestial coordinates can be inferred.

Stellar Background Identification – Celestial Coordinates determination

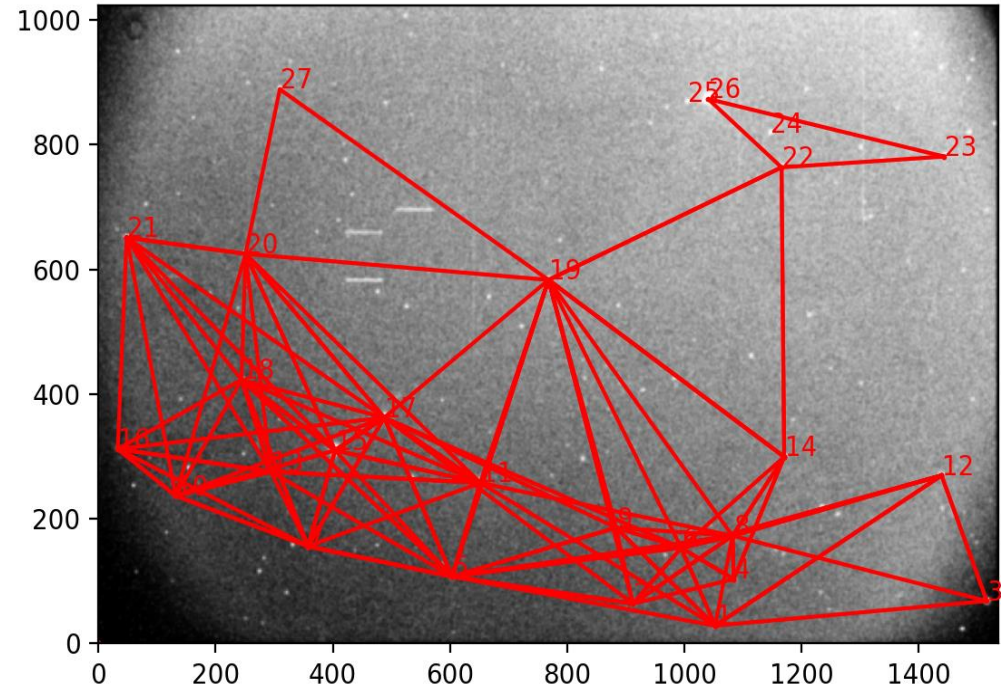


Once stars and objects are identified in the image the celestial coordinates of the center of the image are extracted from the header file.

An index file reporting the triangles characteristics is then generated from the star catalogue Tycho2

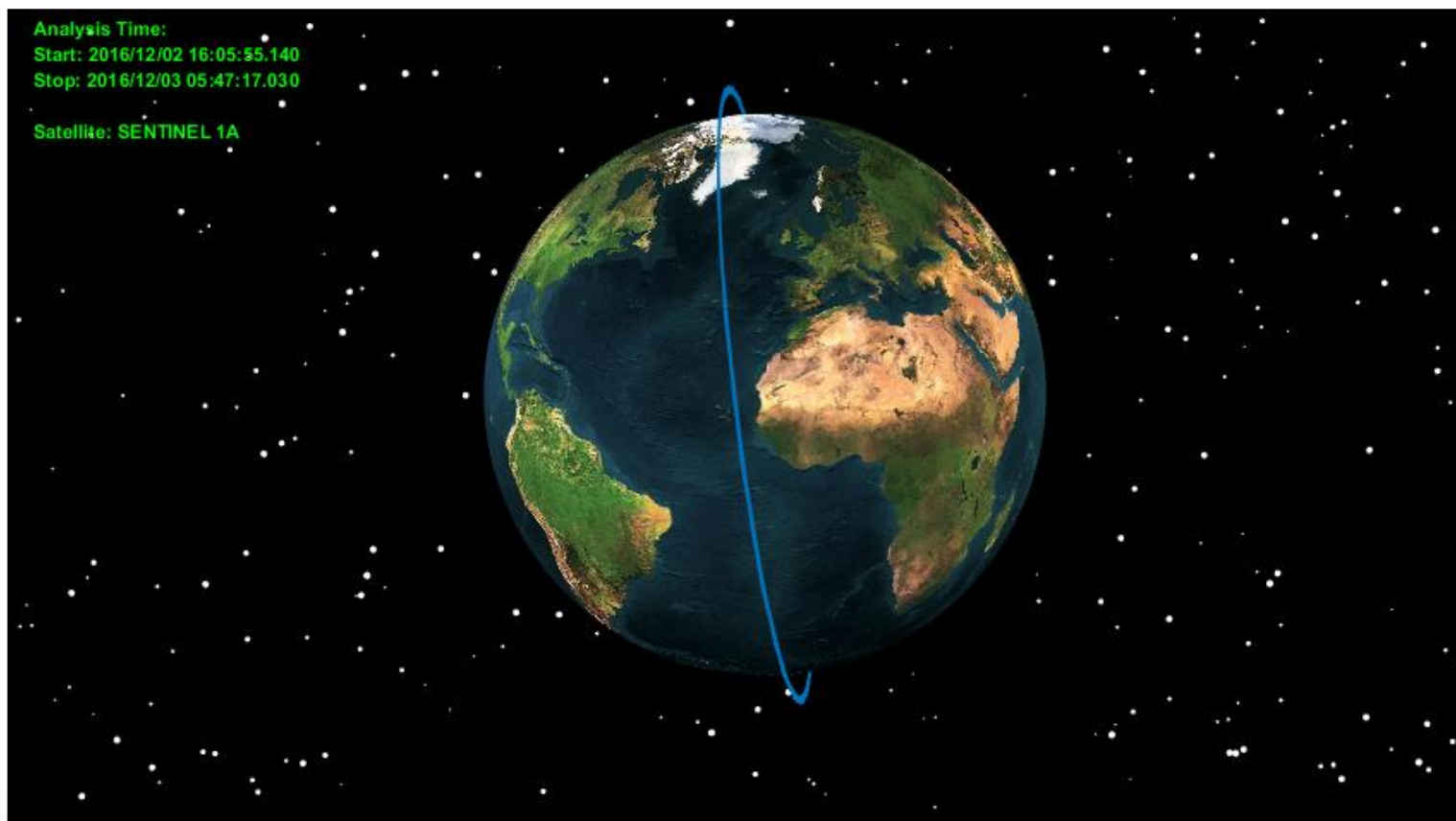
The same file is then generated considering the star positions identified in the image

Image and catalogue index are then scanned looking for matching triangles



Orbit Determination

All the measures are integrated to evaluate the orbital parameter of the object



Introducing GUSDON



- A Global Observation Network for space debris that involves a great number of institutions in all continents
- An invaluable space debris infrastructure with a great educational return in the field of:
 - ❖ Hardware installation, operations, control
 - ❖ Data analysis of raw images
 - ❖ Data integration for orbit determination
 - ❖ Optimal observational strategies evaluation
 - ❖ Light-curve and spectroscopic analyses



Scientific Optical Network



MITO



LOIANO



SCUDO



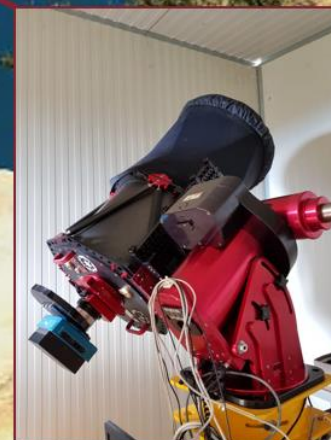
EDUSCOPE



SURGE

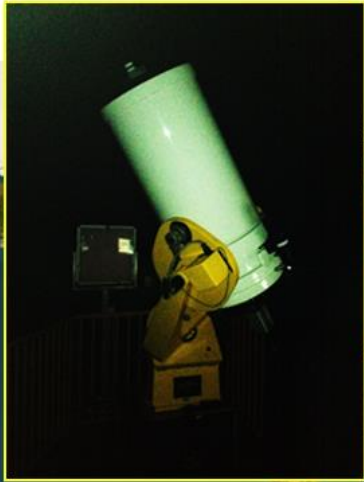


CAMPO CATINO



RESDOS

International Collaborations



ANGELL HALL



ZIMMERWALD



TIRA (RADAR)

MODEST



MAGELLAN



EQUO OG



EQUO OS

Why joining GUSDON?



Space debris research

- An invaluable research tool for identification, monitoring and tracking of space debris
- A potentially critical tool for the observation of re-entering objects

Space debris education

- Students will familiarize early in their University curricula with the space debris issues;
- Students and researchers will be involved in:
 - ❖ Collection of space debris images and observational campaigns;
 - ❖ Angular measurement extraction and raw data analysis;
 - ❖ Advanced space debris determination;
 - ❖ Analyses focused on the space debris attitude determination (photometry, spectroscopy, etc.)