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MATISSE: Multi-purpose Advanced Tool for Instruments for the Solar System Exploration

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Abstract. In planetary sciences, design, assemble and launch onboard instruments are only preliminary steps toward the final aim of converting data into scientific knowledge, as the real challenge is the data analysis and interpretation.
Up to now data have been generally stored in "old style" archives, i.e. common ftp servers where the user can manually search for data browsing directories organized in a time order manner. However, as datasets to be stored and searched become particularly large, this latter task absorbs a great part of the time, subtracting time to the real scientific work.
In order to reduce the time spent to search and analyze data MATISSE (Multi-purpose Advanced Tool for Instruments for the Solar System Exploration), a new set of software tools developed together with the scientific teams of the instruments involved, is under development at ASDC (ASI Science Data Center), whose experience in space missions data management is well known (e.g., Verrecchia et al. 2007; Pittori et al. 2009; Giommi et al. 2009; Massaro et al. 2011) and its features and aims will be presented here.

Key words. Solar System: Asteroids – Solar System: Comets – Virtual Observatory – Intelligent Archive – ESA Rosetta mission – Shape model

1. Introduction

In planetary sciences accessing data acquired by different instruments, in particular those in which experience lacks, is very difficult and therefore data fusion is rarely exploited.

Taking into account that the wealth of planetary exploration missions enormously increased over last years and will likely continue to rise, this limitation is of major importance, as merging together data acquired over the same target by different instruments or at different times would enlarge scientific capabilities of every mission.

Since 2000 ASI Science Data Center (ASDC - formerly BeppoSAX Data Center) has been continuously involved in the management of data and archives of the universe observation mission with Italian participation (e.g., AGILE, Swift and Fermi). ASDC mainly contributes with archiving and analysis tools, allowing scientists interested in the data to use them without the need of writing "*ad hoc*" code.

Therefore it is easy to access and analyze data, in particular thanks to the Spectral Energy Distribution (SED) Tool, by means of which data from different instruments, working

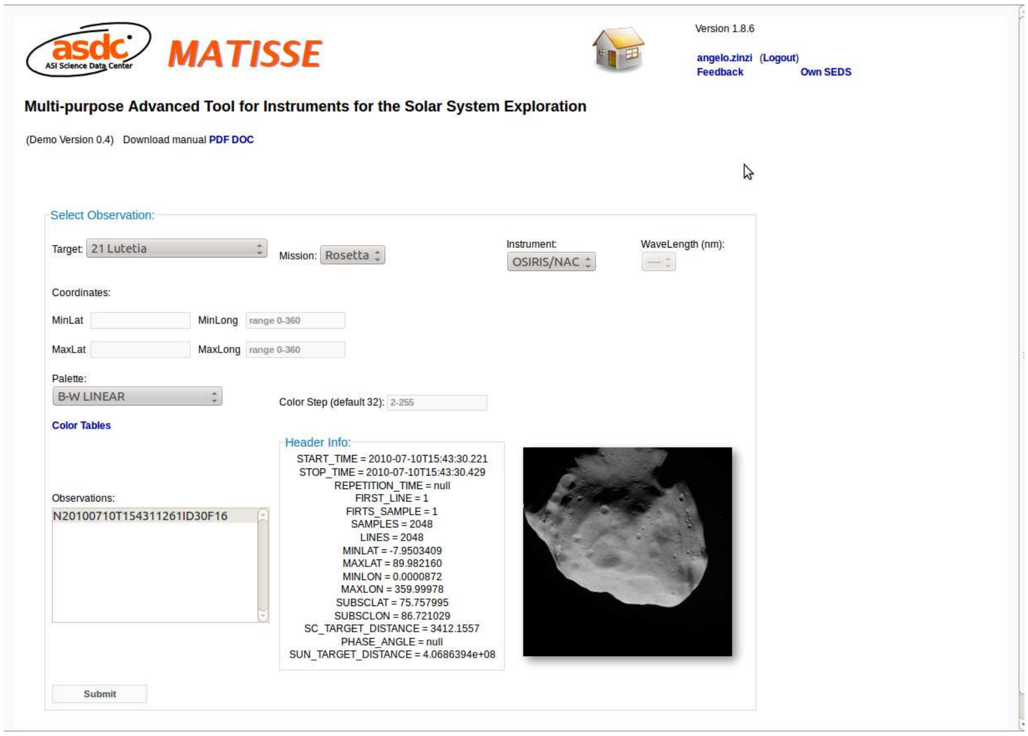

Fig. 1. The homepage of the MATISSE tool

at different frequencies of the electromagnetic spectrum, are plotted together and straightforwardly compared to models.

Following these examples in the field of astrophysics, MATISSE (Multi-purpose Advanced Tool for Instruments for the Solar System Exploration), the new web tool by the Solar System Exploration (SSE) group, is under development at ASDC, designed to be accessible via browser and with no need of installing software. It is thought to allow easier data access and visualization in particular by using:

- intelligent data archiving (possibility to search for data on the basis of different parameters, such as, for example, geographic coordinates, observation geometries or scientific features);
- 3D and projected data visualization (to rapidly look at data coverage of the studied object);
- tools for data analysis and interpretation (avoiding time loss in processing data);
- tools for data fusion (merge together observations made by several instruments allowing a kind of analysis not achievable be each single instruments alone).

During its first year (i.e., 2013) the development of MATISSE is mainly focused to the instruments with Italian participation of the ESA Rosetta mission (Glassmeier et al. 2007): the particle analyzer GIADA (Colangeli et al. 2007), the visible camera OSIRIS (Thomas et al. 1998) and the VIS/NIR imaging spectrometer VIRTIS (Coradini et al. 1998).

Rosetta already visited the asteroids (2687) Steins and (21) Lutetia and is currently en route toward the comet (67P) Churyumov-Gerasimenko: therefore the combined used of the instruments mentioned above would likely improve the scientific capabilities of the mission, as OSIRIS and VIRTIS mainly observe the nucleus and the part of the coma near it,

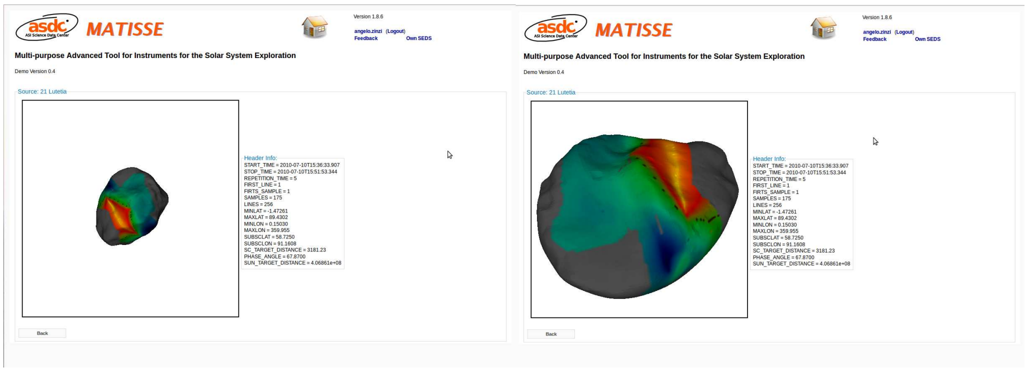

Fig. 2. Two different visualizations of VIRTIS-M IR data on the (21) Lutetia shape model obtained with MATISSE

whereas GIADA is designed to collect and measures particles of the coma, far from the nucles. Combining these characteristics would make it possible to better study both the properties of the coma end of the active regions of the nucleus.

In order to fully exploit data fusion features MATISSE might be provided with Intelligent Archive (IA) characteristics, i.e. the possibility of perform queries crossing several database of interest looking for the best matching data. At the present time this functionality is not yet available, but its project is planned for the end of the year, to fully implement it in the software in 2014.

In particular the users should be allowed to search data by geographic coordinates, acquisition time and, in a next future also by observational features, such as surface/atmospheric characteristics.

2. Current features

Albeit only in a provisional form, MATISSE is already online and its modular structure allows to upgrade it and to quickly integrate other mission and other targets.

One of the key strenght of this tool is the tight collaboration with the scientific teams of the instruments involved, making it possible to develop algorithms best suited to correctly analyze the data.

At the present time a test version is online (Fig. 1), accessible after registration and authorization on the ASDC Tools portal (`https://tools.asdc.asi.it/matisse.jsp`[1]): the current version only allows the use of few public observation acquired by OSIRIS (both NAC and WAC) and VIRTIS-M during the Rosetta's (21) Lutetia flyby.

Once the instrument and the observation has been selected the user can select the area to be mapped and the color table to be used and then the data are visualized over the 3D shape model of the asteroid, while planned upgrades include the possibility of displaying spectra and other data by clicking on the surface (Fig. 2).

3. Conclusions and future works

As already stated above its modular design allows MATISSE to be easily adapted to other mission and targets. In particular one of the most straightforward upgrades of the tool will likely modify it to access data acquired by the VIR instrument (De Sanctis et al. 2011) onboard the NASA's Dawn (Russel et al. 2011) spacecraft that recently studied the asteroid (4) Vesta and is en route toward (1) Ceres.

Furthermore, to fully exploit its data fusion features, in the next future MATISSE

[1] A non registered user accessing that page will be automatically redirected to the login/registration page. After the registration the user must send an email to zinzi@asdc.asi.it in order to be authorized to use MATISSE

should comprehend data from Mars, where several instruments with very different characteristics (e.g., visible cameras, IR spectrometers and subsurface/ionospheric radars) acquired and are currently acquiring data from both surface and atmosphere.

In conclusion after the missions and targets that can be managed and the Intelligent Archive features will be fully available, the use of MATISSE would largely facilitate the use of planetary exploration data, favoring the data fusion and enlarging the scientific capabilities of every mission, likely increasing the scientific production.

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