

Laboratory of Astroinformatics and Digital Planetology

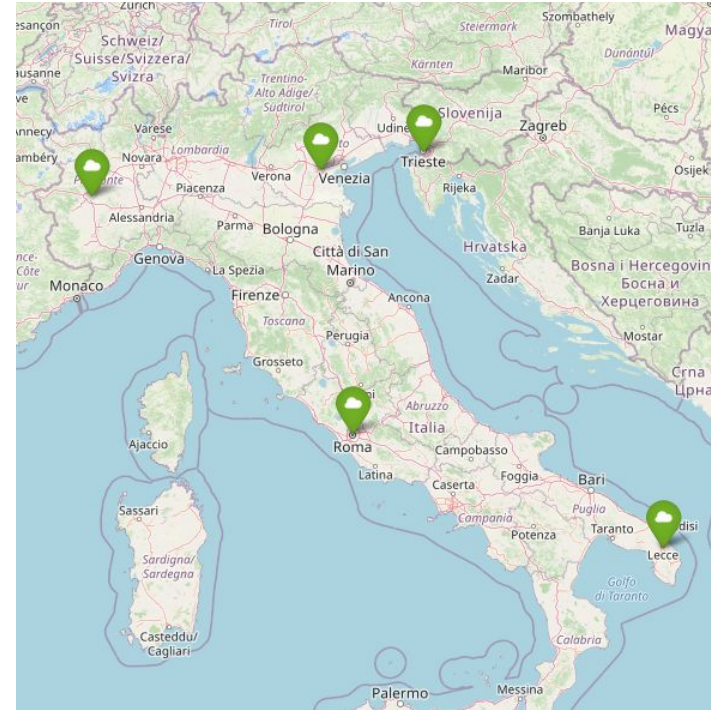
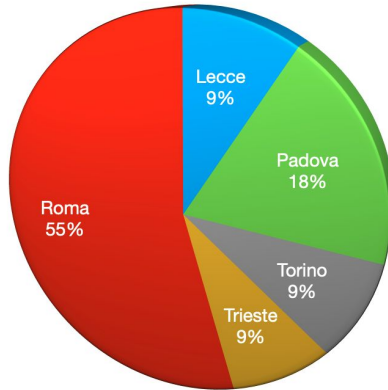


Romolo Politi et al.



LAPD - Geographic Distribution

● Lecce ● Padova ● Torino ● Trieste ● Roma



What's LAPD

LAPD is a "*collective*" whose purpose is the sharing of experiences and knowledge in the field of software products related to astrophysics and planetary science.

Major fields are:

- HPC & HTC;
- Machine/Deep Learning
- Pipeline and Automation;
- Instrument Simulation;
- Archiving;
- Virtualization, Container and DevOps;
- Dissemination and High Education

High Performance Computing – High Throughput computing

- Present in two spokes of the ICSC (PNRR project)
- Computational support for the planetary formation community (Arxes project sheet)
- Impact on multiple INAF projects (space missions Ariel and Juno; INAF PRIN GENESIS-SKA, PLATEA, HOT-ATMOS; Main Stream AMS; large program GAPS2@TNG; ERC SYNERGY ECOGAL project)

HPC

expertise in parallel computing (OpenMP), GPU computing (OpenACC), data parallel computing, software optimization, and tuning on hardware architectures.

Development of HPC codes at INAF:

- Parallel N-body code Mercury-Arxes (development: GPU offloading)
See Polychroni et al. Tue 15/10 @ 14.40
- Parallel collisional code Debris

Cluster Genesis

LAPD manages Genesis, the development and computing infrastructure for the planetary formation community.

Genesis is a cluster of **144 cores** distributed across **6 servers** interconnected at **10 Gbit** on a dedicated network with a **60+ TB** filesystem.

Genesis has also been expanded with 2 Nvidia Tesla V100 graphics cards.

Genesis is also the benchmark platform for codes that are runned on **Pleiadi** and **Leonardo**

Machine/Deep Learning

- Participation in a European Machine Learning project
- Various ML and DL research projects
- Applied study of PINN (Physics Informed Neural Networks)

Pipeline and Automation

Writing, maintenance, and documentation of instrument pipelines for space missions (both uplink and downlink):

- BepiColombo:
 - ISA
 - SIMBIO-SYS
 - SERENA/ELENA
- JUICE – JANUS
- ARIEL

Heritage

- Mars Express - PFS
- Venus Express – VIRTIS
- Rosetta – VIRTIS
- Dawn - VIR

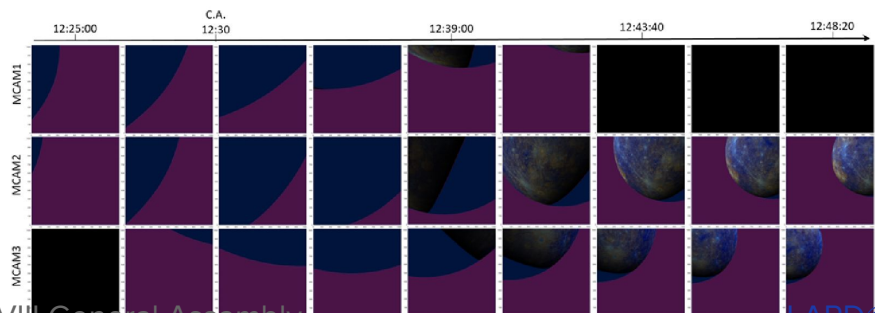
Instrument Simulation

Our group's experience has highlighted the lack, within INAF, of a tool for simulating imaging instruments from space related to the operational aspect of each instrument.

Instrument Simulation

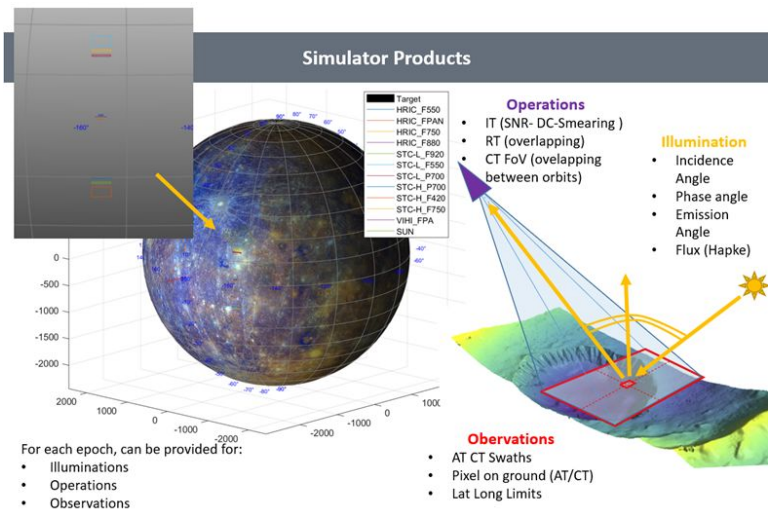
SOIM – Simulator for Operation of Imaging Mission

The tool is currently used for planning SIMBIO-SYS observations. Additionally, it has been requested to use the tool to support the planning of BepiColombo's MCAM observations during Flybys/Swing-bys



23-JUN-2022

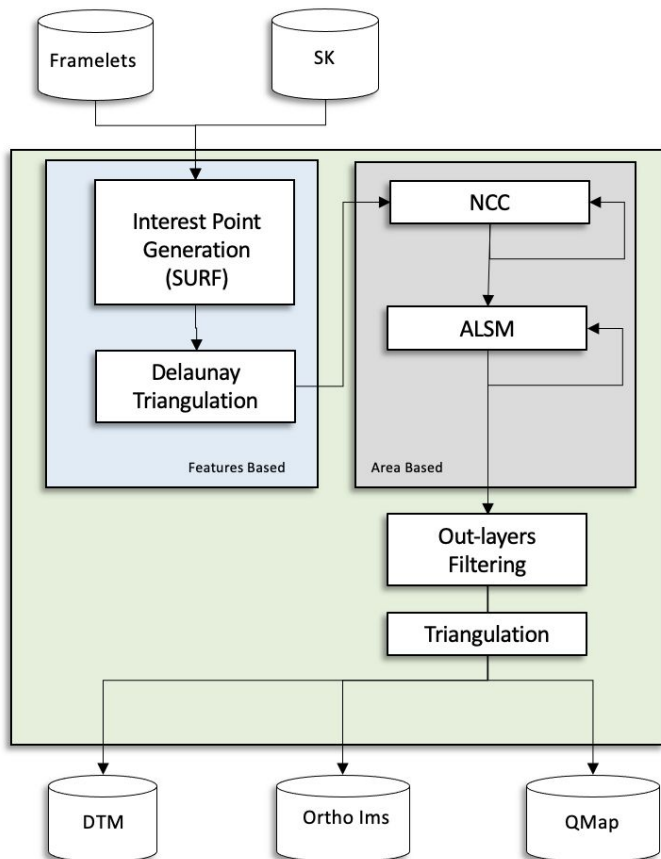
LAPD@inaf.it



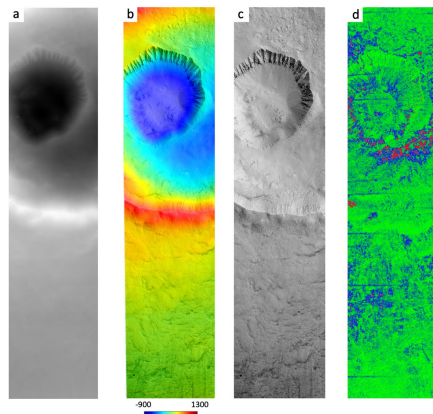
See Simioni et al. Wed 16/10 @ 14:00

2024, October 15th

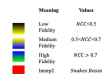
3D Reconstruction



STEREO Products



- a. DTM
- b. Coloured and textured heightmap. Heights (in metres) reported in the colour-bar is relative to the MOLA datum
- c. Panchromatic orthoimage
- d. Figure of Merit.



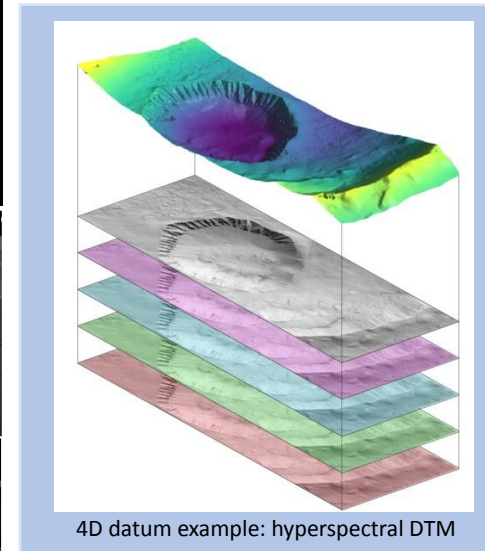
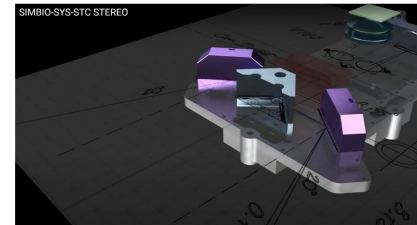
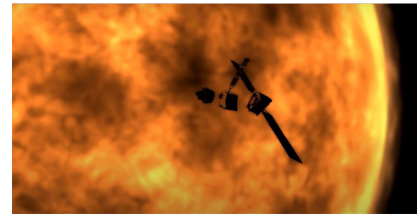
3DPD: Software for the three-dimensional reconstruction of planetary surfaces from the photogrammetric processing of stereo-satellite images. The software was developed by the INAF team in Padua.

Planetary Photogrammetry

From satellite image acquisition, it is possible to generate three-dimensional maps (DTM) useful for numerous scientific analyses. The project aims to provide a substantial contribution to the exploration of aspects related to 'matching' techniques and the development of new approaches and strategies that lead to significant improvements over the preliminary methods already implemented with the Mars images provided by CaSSIS.

OBJECTIVES:

1. Development of new algorithms for 3DPD upgrades to leverage **spectral content** (multi and hyperspectral images).
2. Implementation of innovative algorithms **AI** based.
3. Development of **Data Fusion** techniques to enhance the effectiveness of extracting correlations between different types of data.
4. Application of computer vision/photogrammetry methods and techniques for the **calibration** of satellite or rover-based instruments.
5. Generation of three-dimensional models to provide stereo products for **analysis and scientific dissemination**.



Archiving/Storage

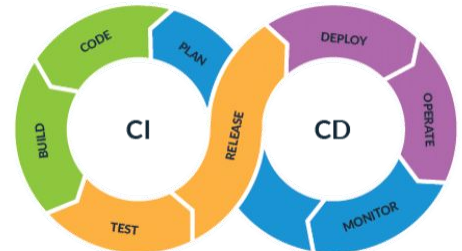
- Production and management of data from space missions
- Design and management of object storage systems
- SaaS for data dissemination (prototype: SIMBIO-SYS Analyzer)
- Multi-database management for laboratory data
- Management of data access systems via WebDav protocols (ownCloud, Nextcloud, Pydio)

Virtualization, Container and DevOps;

- VM Management for Archiving and Dissemination
- Creation and management of containers for the development and deployment of software tools related to space missions and laboratory activities.
- Integration into the **Manticore cluster** of **Kubernetes** and **Jenkins** to develop and test CD/CI systems.



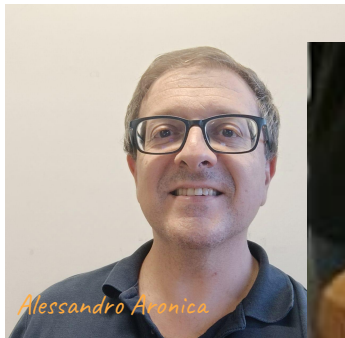
kubernetes



Dissemination and High Education

Courses in PhD schools on Cloud Computing and programming.

Who's LAPD



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