

# Laboratory of Astroinformatics and Digital Planetology

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The Laboratory of Astroinformatics and Digital Planetology (LAPD) is a center of excellence in designing, developing, and optimizing advanced tools and methodologies to support space and planetary research. Its main activities are focused on several key areas:

**1. Development and Optimization of Codes for Simulation and Data Analysis:**

The laboratory creates and refines advanced software codes to simulate space phenomena and analyze complex data from space missions. These codes include algorithms for modeling physical processes, processing images and signals, and simulating future scenarios. The goal is to provide tools that allow researchers to test scientific hypotheses, predict behaviors, and analyze space observation results with high precision.

**2. Hardware Optimization and HPC (High-Performance Computing):**

The laboratory manages and optimizes hardware infrastructure dedicated to high-performance computing, essential for handling and analyzing vast amounts of data. This activity includes configuring and optimizing compute clusters, servers, and other computing resources. Optimization aims to improve system performance, reduce processing times, and ensure efficiency in managing computational workloads associated with complex simulations and large datasets.

**3. Management of Archives and Telemetry Processing Pipelines:**

Data archiving management is a critical function of the laboratory, which handles the collection, organization, and preservation of data collected from space missions. Additionally, the laboratory develops and maintains telemetry processing pipelines, which include automated processes for validating, correcting, and processing raw data. This ensures that data is readily available and ready for analysis, reducing the risk of errors and ensuring data integrity.

**4. Data Dissemination:**

The laboratory plays a crucial role in data dissemination. Through the development of platforms and access tools, the laboratory makes space mission data accessible to the scientific community and the public. Dissemination includes publishing datasets on dedicated repositories, creating web interfaces for data access, and producing documentation and guides to facilitate users' use of the data.

## Cross-Cutting Infrastructure and Involvement in Space Missions

The Laboratory of Astroinformatics and Digital Planetology's expertise and resources are cross-cutting across various research lines, significantly contributing to numerous scientific projects. The laboratory supports a variety of space missions, providing its expertise according to specific project needs. Currently, the laboratory is involved in significant space missions such as:

- **BepiColombo:** A joint ESA and JAXA mission to explore Mercury. The laboratory contributes to developing tools for simulating and analyzing data collected during the journey to and observation of Mercury.
- **Juice (Jupiter ICy moons Explorer):** An ESA mission dedicated to exploring Jupiter and its icy moons. The laboratory supports the processing and analysis of scientific data related to Jupiter's atmosphere and its moons.
- **Ariel (Atmospheric Remote-Sensing Infrared Exoplanet Large-survey):** An ESA mission to study the atmospheres of exoplanets. The laboratory is involved in developing tools for analyzing and simulating the spectroscopic data collected by the space observatory.

## Philosophies and Open Science Practices

The laboratory adheres to the principles of **Free and Open Source Software (FOSS)**, **Findable, Accessible, Interoperable, and Reusable (FAIR)**, and **Open Science**. This commitment translates into making its codes and tools available on public platforms such as **GitHub** and **PyPI**.

- **FOSS:** Promotes transparency and collaboration through the availability of open-source code. The tools developed are shared freely, allowing anyone to view, modify, and contribute to the code.

- **FAIR:** Ensures data and codes are findable, accessible, interoperable, and reusable. The laboratory adopts practices that facilitate the integration of data and software with other tools and resources.
- **Open Science:** Encourages the dissemination of scientific results and methods through public channels, promoting collaboration and innovation. Research results and data are available to the public to facilitate further studies and developments.

With this approach, the laboratory contributes to the advancement of space science and fosters a more inclusive and collaborative research environment, reflecting a commitment to continuous sharing and innovation.

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