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Report of Contributions

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Applying the LISA Science Ground Segment Model to the Lunar Gravitational-wave Antenna

The Lunar Gravitational-wave Antenna (LGWA) mission aims to deploy a network of highly sensitive inertial sensors on the Moon, providing unprecedented observations in the decihertz gravitational-wave band. To successfully manage the data flow and fully exploit the scientific capabilities of the mission, a robust and distributed Science Ground Segment (SGS) must be designed from the earliest phases of the mission, capable of transforming raw telemetry into calibrated data products, science-ready observables, and public data releases while supporting mission operations throughout the lifetime of the observatory. This presentation proposes a conceptual architecture for the LGWA SGS, describing its main functional components and its interfaces with mission and instrument operations, using the LISA SGS model — currently under active development and testing — as a reference.

We outline a distributed processing approach, following the model adopted by medium-to-large missions such as Euclid and LISA, in which the Science Operations Centre is responsible for telemetry processing, mission archiving, quick-look analysis for instrument health checks, and low-latency pipelines up to Level 1 data products. Higher-level scientific processing is instead performed by the Consortium through Distributed Science Data Centres (DSDCs) coordinated via a central software repository. This distributed network is responsible for generating Level 2 data products (e.g. model parameters and posterior probability density functions of identified GW sources) as well as Level 3 products (source catalogues, with their physical and astrophysical parameters). The DSDCs are also expected to support end-to-end mission simulations, used both to validate the processing pipelines and to characterise instrument response, as well as long-term monitoring of instrument performance to track detector health and calibration stability over the mission lifetime.

Finally, we discuss the common infrastructure required to support the SGS, including the definition of a shared Data Model for all the SGS data products, the Mission Database, containing mission configuration, constants and calibration information, a common workflow management system to execute and distribute data processing pipelines, and distributed storage solutions. Central to this infrastructure is a container-based software deployment strategy, designed to seamlessly support not only the mission's data production system but also a prototyping environment, where the Science Team and the DSDC teams can collaboratively develop, test, and validate data analysis pipelines before deployment. We also present the adoption of cloud-native open-source technologies as a foundation for these services, enabling a modular, reproducible, and collaborative infrastructure that can support the long-term evolution of the LGWA mission.

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