A Venezuelan Perspective for the Sustainable Development of Lunar Infrastructure Based on In-Situ Resource Utilization

MSc. Rogelio Morales García

Session 3: Sustainable lunar exploration









# Introduction

In 2023, the **Bolivarian Agency for Space Activities (ABAE)** was invited by the China National Space Administration (CNSA) to join the International Lunar Research Station (ILRS) project. Subsequently, ABAE has been engaged in activities designed to enhance Venezuelan research capabilities, with the objective of establishing the foundations for a viable, sustainable, and long-term development of lunar critical infrastructure.

In this regard, **In-Situ Resource Utilization (ISRU)** is a viable method for collecting, processing, and utilizing lunar regolith for lunar infrastructure, thereby ensuring the sustainability of long-term lunar operations and providing essential resources for the survival of lunar explorers, rather than relying on resources brought from Earth. This approach also enhances the overall capabilities of human exploration.

Finally, lunar construction and operations in extreme environments will require the implementation of autonomous robotic platforms to support future manned and unmanned space exploration.

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# **Four Main Objectives**



# **OBJECTIVE 1**

### In-Situ Resource Utilization

Development of compounds based on in-situ resources for use as construction materials for critical lunar infrastructure. Also, development of a lunar regolith simulant.



# **OBJECTIVE 2**

# Construction

Develop effective construction techniques that can be implemented in the extreme conditions of the lunar environment.



# **OBJECTIVE 3**

# Architecture

Conceptualize, design, and build infrastructure proposals that meet the demanding requirements of lunar activities and operations.



# **OBJECTIVE 4**

## **Autonomy**

Advanced management of logistics, construction, and operation of lunar infrastructure with autonomous artificial agents.

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## INSTITUTIONS INVOLVED





**1** Institute of Materials and Structural Modeling (IMME)

[2] School of Geology, Mines and Geophysics

[3] School of Metallurgy and Materials Science

[4] Graduate Program in Physics of Non Destructive Testing





**[5]** Experimental Construction Development Institute (IDEC)

### LINES OF RESEARCH

#### Swarm Robotics Exploration & Construction

Swarm Robotics: A New Paradigm in Robotic Space Exploration.

#### Autonomous In-Situ Resource Utilization & Construction

Obtaining a High-Density Basaltic Cementitious Compound by Using Compaction Techniques to Improve its Physical and Mechanical Properties for Future Lunar Infrastructure Construction.

Characterization of the Physical and Mechanical Properties of Compacted Basaltic Cementitious Compounds for Use as an In-Situ Resource for Lunar Infrastructure Development.

Comején: An Intelligent Autonomous Geological Surveyor and Regolith Processor for Lunar Infrastructure Construction.

#### Welding and NDT in Space Environments

Welding Under Microgravity Conditions: Experimental Rationale, Background, and Approach by the Universidad Central de Venezuela Team, Awardee of the 2024 DropTES.

Nondestructive Testing in Space Environments: A Critical Element for the Future Sustainability of Aerospace Development. A Venezuelan Perspective for the Sustainable Development of Lunar Infrastructure Based on In-Situ Resource Utilization

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