

AEROSPACE ENGINEERING

DIMEAS - Advanced VR and eXtended Reality Tools for LPR Cockpit Design, Human Factors, and Astronaut Training

Funded By	Dipartimento DIMEAS
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Context of the research activity	The research focuses on the development of advanced Virtual Reality (VR) and Extended Reality (XR) tools for the design and evaluation of the Lunar Pressurized Rover (LPR) cockpit, astronaut training, and human-machine interaction. Activities include CAD modelling of the cockpit, physically consistent digital twin development, and integration into a mobile simulation platform in collaboration with the University of Enna Kore and Thales Alenia Space.
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	<p>This PhD activity will be carried out within the Space It Up project and in collaboration with Thales Alenia Space Torino and the University of Enna Kore, with the aim of developing advanced VR/XR-based methodologies and tools for the design, validation, and operational training of the Lunar Pressurized Rover (LPR) cockpit.</p> <p>Future lunar missions will require astronauts to perform complex navigation, docking, and surface operations in highly constrained and hazardous environments. The design of the LPR cockpit, including its layout, visibility, control interfaces, and human-machine interaction characteristics, is therefore essential to ensure safe and efficient rover operation. Advanced VR/XR tools, combined with physically consistent digital twins, represent a powerful enabler for design iteration, usability assessment, and immersive training.</p> <p>The research will focus on four main areas:</p> <ol style="list-style-type: none"> 1. Development of VR and Extended Reality tools for cockpit design and human factors <p>The activity involves creating VR/XR environments for analysing LPR cockpit ergonomics, visibility, control placement, and human-machine interaction. Key tasks include:</p> <ul style="list-style-type: none"> * building immersive virtual scenarios from CAD models; * evaluating workload, situational awareness, and user experience;
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Objectives

- * studying human–system interfaces (HSI) under lunar operational constraints;
- * supporting iterative cockpit design and requirements verification.

2. CAD modelling and geometric definition of the LPR cockpit

The PhD student will work on detailed CAD modelling of the LPR cockpit interior, including workstation layout, displays, controls, viewports, and structural integration.

Tasks include:

- * definition of cockpit geometry consistent with mission requirements;
- * adaptation of CAD models for VR/XR visualization and simulation.

3. Development of a physically consistent digital twin of the LPR

A digital twin will be developed to simulate rover behaviour during driving and operational scenarios on the lunar surface.

Research topics include:

- * modelling rover dynamics, traction behaviour, visibility constraints, and operator feedback;
- * coupling the digital twin with VR/XR systems to provide real-time immersive simulation;
- * inclusion of environmental features such as regolith, slopes, reduced gravity, and lighting conditions;
- * support for operational procedure testing and astronaut training.

4. Integration into a mobile simulation platform (Enna Kore collaboration)

The VR/XR and digital twin tools will be integrated into an advanced mobile simulation platform developed with the University of Enna Kore.

Activities include:

- * synchronization of VR/XR cockpit environment with the physical motion platform;
- * simulation of rover manoeuvres, docking approaches, and hazard avoidance;
- * development of training modules for astronaut operations;
- * validation through user studies and expert evaluation.

Skills and competencies for the development of the activity

Background in design, mechanical, aerospace, or computer engineering. Experience with VR/XR development, CAD modelling, and simulation environments is advantageous. Interest in human factors, vehicle dynamics, digital twins, and space engineering is highly desirable. Programming skills (Unity/Unreal, Python, MATLAB) are an asset.