

ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

DET - Optical systems and sensors for space applications

Funded By	Dipartimento DET
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Context of the research activity	The return of humans to the Moon requires advanced engineering solutions to ensure the sustainability of future missions. One of the key challenges is the reliable transmission of energy in extreme environments where conventional power sources are limited. Laser Wireless Power Transmission (LWPT) is emerging as the most promising solution to provide power to rovers, habitats, and other surface systems.
Objectives	The activity, partly conducted within a project funded by the Italian Space Agency (ASI), aims to develop technologies for laser wireless power transmission to enable energy delivery to permanently shadowed regions of the Moon, such as polar craters, and to support operations during extended lunar nights. These environments pose limitations for conventional power generation and distribution systems, motivating the investigation of alternative approaches for energy transmission to support long-duration lunar exploration and infrastructure. In more detail, the activity focuses on the design and integration of optical systems and sensing technologies for space applications, with particular emphasis on laser-based systems. The development of optical sensing subsystems for beam monitoring, alignment, pointing, and diagnostics is essential to ensure accurate beam delivery, high transmission efficiency, and stable operation of laser-based systems in space. The activity also includes the design of high-efficiency laser sources and associated optical subsystems, integrated with sensing and control functionalities. Specific attention is devoted to challenges related to operation in the space environment, including mass and volume constraints, thermal management of optical and optoelectronic components, and radiation effects on sensors, optical materials, and detection systems. The activity further investigates long-term degradation mechanisms affecting sensor accuracy, calibration stability, and overall system performance.
Skills and competencies for the development of	The activity requires background knowledge in optics, photonics, measurements, and electronics, with particular competence in laser systems, optical sensing technologies, and data processing. Familiarity with both numerical modeling and experimental laboratory work is expected.

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