ENERGETICS

DENERG - Development of the thermal control system of a satellite for the wireless power transmission of electricity on the Moon

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Context of the research activity	The presence of future bases on lunar soil will lead to an increasing need for energy supply on the Moon. Traditional methods of power generation and distribution are not suitable for working in a lunar environment. Therefore, in the framework of the DESIGN project a technological solution to the lunar energy problem, based on the concept of Wireless Power Transmission (WPT), is proposed. The architecture consists of a constellation of satellites that represents the infrastructure for the generation and transmission of power for activities on the lunar surface. The thermal conditions under which such satellites need to operate must be controlled in detail to allow their proper operation, and this is the target of the proposed PhD activity. (Borsa interamente finanziata con progetto del Dipartimento Energia.)
Objectives	After a preliminary analysis on the state of the art of the thermal management systems that can be adopted in a space environment, the mission and system requirements will be defined. Active and passive thermal control approaches and systems will be evaluated to identify which are the most efficient and reliable exchangers and solutions for the proposed application, possibly adopting hybrid solutions. It will also be essential to identify an overview of possible hardware and related weights. The definition of the significant terms for the thermal balance of the system will follow. Then, the final CAD design of the entire satellite will be carried out, to perform preliminary thermal analyses to understand which components are not within their operating ranges. Once the satellite CADs and the first results of the preliminary simulations will be available, the analysis of the entire thermal control system will be performed focusing on two main cases: cold case (in the shadow zone of the satellite) and hot case (in the daylight zone), with the aim of calculating and processing the internal temperatures and external elements of the satellite and its components. This will allow to verify that these temperatures meet the design ranges.

Skills and competencies for the development of the activity	This project on one hand will require thermal and mechanical/aerospace competencies for the understanding of the physical phenomena being modelled; on the other hand, numerical modelling skills (both CAD and thermal) related to the computational analyses that will be performed to design the thermal system and its controls will be required and furtherly developed during the PhD activity.