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New Missions Enabled by New Propulsion Technology and Systems (9)

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COMPARISON OF THE PERFORMANCES OF DIFFERENT PROPULSION SYSTEMS FOR A  
TRANSFER FROM THE MOON SURFACE TO VENUS

**Abstract**

Due to its harsh environment conditions for spacecraft survival, Venus has not yet been explored extensively, keeping still much science to uncover. However, according to VEXAG (Venus EXploration Analysis Group), its study could have crucial relevance in better understanding the planetary evolution mechanisms, helping us in the analysis of the exoplanets and also foreseeing the future evolution of the Earth.

In the context of a possible Venus exploration mission, a feasibility study has been carried out in order to analyse and compare different propulsion systems to perform the transfer from the Moon surface to Venus. The work is based on the proposal of the LUPO (LUNar Propellant Outpost) project, developed in previous editions of the international Specializing Master programme in Space Exploration and Development Systems (SEEDS). LUPO plans the installation of an outpost on the lunar surface in order to produce propellant in-situ. In particular, using electrolysis processes, it would be possible to obtain liquid oxygen and liquid hydrogen from the water in icy-regolith. The Moon, with such a propellant facility, could be exploited as a new launch base to other celestial bodies, optimizing the overall cost of future missions. Starting from LUPO proposal, a liquid rocket engine (LO<sub>2</sub>/LH<sub>2</sub>) has been considered, then its performance has been compared with those of more advanced propulsion systems which exploit different power sources. All the results obtained are discussed in detail in order to find the solution that optimizes the orbital transfer for different mission requirements.

The study has been carried out within the frame of the XIII edition of SEEDS. SEEDS Master programme gathers students from three European universities: Politecnico di Torino (Italy), ISAE-Supaéro (France) and University of Leicester (United Kingdom) and involves them in a 6-month project work on space exploration with the support of prominent European space actors such as Thales Alenia Space Italy, the Italian Space Agency (ASI), the French Space Agency (CNES) and the European Space Agency (ESA).