



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

THEMATIC Research Field: ADVANCED TOOLS FOR PLANETARY IN SITU RESOURCE UTILISATION TECHNOLOGY DEVELOPMENT

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	<p>The systematic exploitation of local resources is crucial to support future manned outposts, which would lead to significant independence from the terrestrial resources refurbishment which would be unbearable the longer the outposts are supposed to last. So planetary resource utilisation is a key capability towards future missions feasibility. Nowadays technologies needed to implement and operate a planetary plant for in-situ resource management from terrain prospecting and sampling to manipulation and processing up to the aimed final product are slowly progressing to answer each aforementioned functionalities. A common critical aspect stays in understanding and properly modelling the terrain interaction with artefacts to get to a robust technology design. The research focuses on finalizing a validated virtual framework to drive the design of each building block of an ISRU plant and simulate its operational phases with strong attention to the soil interaction aspects. The use case to work around, not limited to relates to the advanced project of the demo ISRU payload for water extraction on the Moon to be flown in the short future. The virtual model is expected to be validated through lab experiments run on dedicated breadboards for soil characterization</p>
Methods and techniques that will be developed and used to carry out the research	<p>The research will be developed in strict collaboration with a National Space Agency involved in flight opportunity preparation. Both numerical and experimental activities</p>



	<p>preparation. Both numerical and experimental activities will be carried out with a particular focus on granular material (non-cohesive sands) dynamics modelling and solid-gas, solid-solid interaction assessing the best fitting to the problem of DEM and SPH techniques. It is expected to adopt a virtual reality framework to develop the framework for ISRU plant operations in dirty environments and to realize\support lab tests for the plant and mission development. A period between 6 and 12 months, not necessarily continuous, might be spent at an external premise to deepen specific topics related to the research, such as planetary terrain characterization. The doctoral student will follow doctoral courses at the Doctoral School of the Politecnico di Milano, selected to enhance his/her competencies in the fields related to the research topic.</p>
<p>Educational objectives</p>	<p>The specific objective of this PhD is to develop skills in space exploration system engineering with particular attention to the emerging field of In Situ Resource Utilisation and its building blocks to properly work on planetary surfaces with particular focus, but not limited to, the first block of the lunar manned outpost. Being the research area intrinsically multidisciplinary, the candidate will gain competencies in multiphysics modelling, complex experiments design, implementation, setup and running, natural\artificial materials interaction management and planetary science.</p>
<p>Job opportunities</p>	<p>The job opportunities that this project opens up are in the field of space system engineering, from the design to the implementation and operations management. Skills acquired will give access to jobs related to complex and technologically advanced plant engineering and management in the Earth industrial field as well.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 0 Associated Professors 2 Assistant Professors 13 PhD Students</p>
<p>Name of the research directors</p>	<p>Prof. Michelle Lavagna</p>



Contacts

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Additional support - Financial aid per PhD student per year (gross amount)

Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad

Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

The PhD candidate will receive a desk, possibly through a hot-desking procedure, and a personal computer, if needed. Apart from the compulsory ones, the PhD candidate will have the opportunity to follow additional courses and receive economic support to attend summer schools and participate in conferences. There will be the possibility of paid teaching assistantship.