



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 38th cycle

THEMATIC Research Field: MISSION ANALYSIS FOR CISLUNAR MISSIONS

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

The miniaturization of components has enabled nanosatellites, or CubeSats, which are shoebox-sized systems able to carry out scientific investigations like conventional spacecraft. CubeSats have reduced the entry-level cost in low Earth orbit by one order of magnitude. While CubeSat missions are standard in LEO, using them beyond Earth is challenging, being the Moon the next frontier. Momentum is building for space missions in the cislunar environment. This environment provides us with a unique opportunity to explore the space between Earth and the Moon. These yield knowledge to develop better technologies for space exploration and to plan more efficient mission trajectories. Additionally, exploration of the cis-lunar environment is necessary to gain a better understanding of the resources available for long-term space exploration and settlement. In this context, deep-space CubeSats will be used alongside conventional spacecraft to augment the technological and scientific return of the missions.

Methods and techniques that will be developed and used to carry out the research

The research aims at improving state of the art on mission analysis design coupled with guidance, navigation, and control for missions in the cislunar environment, with LUMIO being the main study case. LUMIO is a mission to monitor the lunar farside that will orbit about the second Earth-Moon Lagrange point, and as such it requires innovative trajectory design methods. The Ph.D. candidate will investigate the field, developing and implementing solutions that best fit the scenarios of



	interest. Simulations will be conducted by exploiting a laboratory environment to validate the proposed methodologies. A period abroad is envisaged to apply and test the developed methodologies in relevant institutions.
Educational objectives	The objective of this Ph.D. is to develop skills in mission analysis design and in the context of guidance, navigation, and control. The candidate will gain relevant expertise in deep-space CubeSat missions, focusing on the cislunar environment. Through this project, the candidates will develop skills in mathematical modeling, numerical analysis, and computer programming (Matlab, Python, C++, or similar). Moreover, the candidate will develop skills in both computer and processor/hardware-in-the-loop simulations. Soft skills in disseminating the research, writing reports, performing outreach, and preparing industrial progress meetings will also be achieved through the Ph.D. project.
Job opportunities	The current research prepares the Ph.D. candidate for both academic and industrial careers. Knowledge of mission analysis and guidance, navigation, and control experiences are fundamental skills for space careers in companies and universities.
Composition of the research group	1 Full Professors 0 Associated Professors 3 Assistant Professors 16 PhD Students
Name of the research directors	Prof. Francesco Topputo

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	2100.0 €
By number of months	6

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

The Ph.D. candidate will receive a desk and a personal computer. Apart from the compulsory ones, the Ph.D. candidate will have the opportunity to follow additional courses, receive economic support to attend summer schools, and participate in conferences. There will be the possibility of paid teaching assistantship.