POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 37th cycle

THEMATIC Research Field: MISSION ANALYSIS AND AUTONOMOUS GUIDANCE, NAVIGATION, AND CONTROL FOR DEEP-SPACE CUBESATS WITH APPLICATIONS TO FAR- AND CLOSE-PROXIMITY OPERATIONS

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, that 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. Yet, the current paradigm of adopting ground-based navigation and control techniques prevents their usage for deep-space exploration. Real-time operations such as landing, collision avoidance, spacecraft inspection, formation flying rendezvous, and docking cannot be guided from the ground due to the significant time delay, which is not admissible in such fast dynamic environments. Autonomous guidance, navigation, and control capability in far and close-range operation scenarios would enable cheaper, real-time, and safer mission operations by shifting the current navigation and control routine from ground to aboard satellites. The objective of this research is to derive and demonstrate the feasibility of autonomous guidance, navigation, and control methods for deep-space CubeSats in relevant far-range and close-range mission scenarios.
Methods and techniques that will be developed and used to carry out the research	The research aims at improving the state of the art on mission analysis design coupled with autonomous far- and close-range guidance, navigation, and control techniques. The PhD candidate will investigate the field,

	developing and implementing solutions that best fit the scenarios of interest. Simulations will be carried out exploiting a laboratory environment to validate the proposed methodologies. In particular, the candidate will have the chance to apply his research in an applied context. A period abroad is envisaged to apply and test the developed methodologies in far and close-proximity operation scenarios.
Educational objectives	The objective of this PhD is to develop skills in mission analysis design and in the context of autonomous guidance, navigation, and control. The candidate will gain relevant expertise in deep-space CubeSat missions. 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 be also 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 0 Assistant Professors 11 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	--

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

Scholarship Increase for a period abroad	
Amount monthly	564.01 €
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, a personal computer. Apart from the compulsory ones, the PhD candidate will have the opportunity to follow additional courses, to receive economic support to attend summer schools and participate in conferences. There will be the possibility of paid teaching assistantship.