POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 39th cycle

THEMATIC Research Field: CLOSE PROXIMITY INTELLIGENT ROBOTICS FOR IN SPACE SERVICING

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	Strong attention is given in Space to the near-Earth ecosystem and environment preservation, dangerously attacked by the enormous amount of dead parts left orbiting around forever. More, satellites come to their end of life, just because of fuel depletion or a single fault event, even if still healthy to service. The capability to either remove orbital debris or to refurbish and maintain space assets to prolong their operational life is fundamental to contribute to both Space and Earth ecosystem preservation: On-orbit servicing would contribute to sustainable development, limiting the on-Earth resources waste to support the whole supply chain for new, replacing satellites production. On the other hand, the need for large in-space infrastructure assembly is growing to support advanced science and exploration. On-orbit unmanned proximity operations are a frontier and dedicated SW/HW need to be studied, developed and tested. The research aims at investigating, implementing and verifying, through numerical and experimental activities, techniques and architectures for robotics design, navigation and control involved in very close space operations
Methods and techniques that will be developed and used to carry out the research	The research focuses on identifying, designing and assessing new approaches for robotics architectures, navigation and control strategies, devoted to interacting, from close proximity to contact and berthing\docking with heterogeneous space objects not necessarily perfectly

	heterogeneous space objects not necessarily perfectly known. Attention will be given to the effectiveness of adopting learning techniques and distributed architecture with respect to and possibly coupled with more classic GNC solutions to enhance the robustness of the autonomous operation against the highly variable and uncertain working environment. The starting point will assume robotics articulated appendages as arms, not limited to. The robotics dynamics and control will be treated as coupled with the carrying vehicle GNC. If a first period the most dedicated to numerical modelling is foreseen, assessment of the proposed solutions is expected to be experimentally verified as well, settling a proper environment in the lab.
Educational objectives	The specific objective of this PhD is to develop skills in in-space autonomous servicing through robotics appendages, with attention to autonomous very close proximity navigation and safe control, and capture/contact mechanisms design. Through this project, the candidate will develop skills in mathematical modelling, numerical analysis, experiments setup and runs and techniques belonging to the Artificial Intelligence area. Both areas - are quite attractive in a broad industrial domain, not limited to space. The candidate will then acquire an attitude open to innovation with a general focus on the preservation of the terrestrial and space ecosystem, through technological innovation and promotion of sustainable development. In this sense, education will be complemented by a broad variety of soft skills, including presentation of the research, report writing, outreach, and dissemination.
Job opportunities	The job opportunities that this project opens up are in the field of space systems engineering HW/SW design, development and testing, GNC design and testing, robotics for space, Clean Space and Debris management, On-Orbit Servicing and assembly. Because of the multidisciplinary topics, job opportunities are not limited to the Space entourage but include industrial compartments strongly affected by autonomy and robotics.

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Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 10 PhD Students
Name of the research directors	Prof. Michelle Lavagna

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	700.0 €
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.