

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

THEMATIC Research Field: ADVANCED IMAGING FOR AUTONOMOUS PLANETARY NAVIGATION

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	The proposed research deals with imaging exploitation to support navigation in planetary environment to enhance the current processing approach to the new emerging hardware solutions. Image sensors are typically part of the sensor suite on board space vehicles which present a certain level of autonomy for the environment perception and dynamics control. Together with new techniques to extract information even on loosely defined, badly illuminated and crowded scenes in unknown natural environment, the research also moves in the direction of enhancing the related hardware, optics and processing backend to support fast and robust interpretation of the scenario. The research wants to investigate the adoption of new image processing techniques whenever the hyper wide optics and low-energy processors are adopted to support surface proximity and fast dynamics scenarios in space, like landing and planetary exploration. The aim is, through a dedicated experimental campaign to assess the most promising architecture to adopt to get the needed robustness and accuracy when adopting the new hardware solutions.
Methods and techniques that will be developed and used to carry out the research	The research will take advantage of the state of the art in the research group for image processing and the available experimental facilities to first settle virtual models for the new adopted sensors (e.g.spherical lenses) and the scenarios of interest (landing, surface mobility, caves, craters exploring), define metrics to adopt to assess the



	craters exploring), define metrics to adopt to assess the classical algorithms applicability, and run the evaluation campaign. Then, techniques to tune the quality of the state reconstruction will be investigated, taking advantage, if need of Al-based classifiers and the new emerging bioinspired strategies. The next phase of the research it is expected to settle the experimental framework to calibrate the numerical simulator with real acquisition in lab, equipped with the advanced lenses and computational boards. The experimental campaign will be twofold: to enhance a synthetic images database, and to verify and validate the image generator. The research will then run a comprehensive simulation campaign on scenarios tuned to stress the whole sw\hw architecture capability and compare its performance with respect to classic approaches adopted in image based navigation in space.
Educational objectives	The specific objective of this PhD is to develop skills in new techniques and sensors for autonomous navigation image based, on planetary exploration scenarios, including a strong experimental activity. The candidate will refine his/her competences in mathematical\numerical modelling, and experimental campaign settling and running. Moreover, he/she would enhance his/her knowledge in the area of AI techniques for image processing; during his/her research period he/she will get in contact with external entities, public and private being the topic quite in line with many on going activities in the group. Technical education will be complemented by a broad variety of soft skills, including presentation of the research, report writing, outreach, dissemination, and preparation of progress meetings.
Job opportunities	The job opportunities that this project opens up are in the field of autonomous navigation, sensor modelling and measurements management, experimental campaign settling and running for V\V, GNC for planetary exploration and system engineering not limited to the space industrial parterre.
Composition of the research group	1 Full Professors 0 Associated Professors

POLITECNICO DI MILANO



	3 Assistant Professors 10 PhD Students
Name of the research directors	Michèle 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	750.0 €	
By number of months	0	

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.