



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 39th cycle

THEMATIC Research Field: THERMAL IMAGING FOR FLEXIBLE IN SPACE 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	<p>Onboard autonomy is a crucial capability Space assets are the more requested to gain to ensure timeliness and flexibility with the encountered environmental conditions along their operational life, not always perfectly known in advance. Imaging is a promising and actually already exploited technique for environment sensing and possibly converting into self-localisation. However, the visible band has been exploited so far, mimicking human capabilities and constraining its exploitation to the scene illumination condition. The proposed research broadens the imaging sensing to the thermal infrared band, with the aim of assessing its effectiveness in supporting autonomous navigation and environmental knowledge acquisition to increase space vehicle onboard autonomy and mission robustness. The capability to properly reconstruct the close environment - any proximity object shape and dynamics included - is fundamental before starting any close proximity, approach and maybe contact operations to preserve safety. The research wants to first build a synthetic environment for IR imaging generation and, secondly, assess the applicability of VIS image processing techniques, to IR as well, to settle a proper processing chain for that set of measurements, stand-alone or fused with different sets of onboard sensors outputs, VIS images included.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The research entails both numerical and experimental activities. Techniques to synthetically generate high-fidelity thermal-IR images will be identified and</p>



	<p>implemented to build up a reliable database; IR camera modeling and different class of scenarios will be included. To this end, validated thermal modeling for different targets in space will be implemented with the privilege of artificial assets (i.e. space artefacts). As the validation of synthetic IR image generation is critical to ensure a reliable image processing chain afterwards, time will be devoted to identifying, settling and running a validation campaign, possibly based on experiments and IR image acquisition in relevant environments (vacuum, controlled thermal cycling). The research will then assess the effectiveness of VIS image processing techniques on IR images, to consolidate a pipeline to elaborate those new measurements on board, mainly for autonomous localization and navigation purposes.</p>
<p>Educational objectives</p>	<p>The specific objective of this PhD is to develop skills in high-fidelity synthetic environment generation with attention to imaging in the IR band and image processing and manipulation to extract relevant information to be further exploited depending on the application. The candidate will refine his/her competencies in mathematical\nnumerical modeling, and experimental campaign settling and running. Moreover, being involved in research aligned with the current Space Agencies plans, he/she will have the opportunity to learn to interact with external entities, public and private. 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.</p>
<p>Job opportunities</p>	<p>The job opportunities that this project opens up are in the field of space robotics, space GNC engineer and system engineering for the broad domain of robotic space missions. Jobs are not limited to space-related industries but include companies which benefit from process automation and autonomy enhancement through imaging.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 0 Associated Professors 2 Assistant Professors 10 PhD Students</p>



Name of the research directors	Prof. Michelle Lavagna
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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.