



# PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

**THEMATIC Research Field: SPACE MISSIONS CONTRIBUTION TO THE SUSTAINABILITY  
ON EARTH AND IN SPACE**

**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**

Space assets in orbit around the Earth and beyond offer services of social and economic benefit to humankind and allow monitoring the conditions on our delicate planet. The 2030 Agenda for Sustainable Development, subscribed by all the United Nations (UN) member states in 2015, set 17 Sustainable Development Goals (SDGs) towards a sustainable thriving of humankind and the planet. As recognised by the UN and space agencies, space missions contribute to the achievement of the SDGs and support through remote sensing mission and telecommunication mission sustainability on Earth. On the other side, as our life is becoming more and more interconnected thanks to satellites, and space is more easily accessible, Space can be seen as the extension of our planet biosphere. As such, long-term sustainability of space activities will be possible in the next decades only if a change of behaviour is put in place by space-faring nations and spacecraft operators. It is therefore important to assess the impact of space debris and space missions on the long-term sustainability of the space environment, both in terms of space debris impact and in term of light pollution and atmosphere pollution.

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

This PhD research is part of the GREEN SPECIES project. The goal of this PhD is to develop different indicators to contribute from the scientific point of view to the policy discussion on Space sustainability and Space for Earth sustainability. This research will develop an



for Earth sustainability. This research will develop an indicator to measure the social benefit of a mission to humankind and to measure the economic benefit of a mission in terms of revenue to then map the benefit of space mission towards the achievement of the SDGs in a clear and quantitative way. Preliminary work has demonstrated the ground-braking nature of this work [1]. On the other side, to advance the evaluation of the impact of space mission on space sustainability, through a brightness model developed in Politecnico di Milano [2] we will define a light pollution index. Such an index is an indicator that define the light pollution generated by a spacecraft, and particularly a constellation. Moreover, an active debris removal index to select the preferred target for active debris removal missions will be also defined [3]. Such indicators will be aggregated among them and also with other contributions such as the debris indicator developed within the THEMIS tool [4] to create a space sustainability index as proposed in [5]. As an application we will collaborate with the Global Space Operators Association (GSOA) to enhance the adherence of large constellations to the GSOA Code of Conduct.

[1] Santoro V. and Zuliani C., "Social benefits assessment of Earth observation missions through the Sustainable Development Goals 2030". MSc. Thesis in Aerospace Engineering, Politecnico di Milano, Italy, 2021.

Supervisors: Colombo C., Nugnes M.

[2] Gerardo Littoriano, Camilla Colombo, Alessandro Nastasi, Carmelo Falco, "Modelling of spacecraft apparent brightness A study on OneWeb constellation satellites", Advances in Space Research, Vol. 74, Issue 3, 2024, pp. 1392-1409.

[3] G. Borelli, M. Trisolini, M. Massari, and C. Colombo. A comprehensive ranking framework for active debris removal missions candidates. 4 2021.

[4] Colombo C., Muciaccia M., Giudici L., Gonzalo J. L., Masat A., Trisolini M., del Campo B., Letizia F., Lemmens F. "Tracking the health of the space debris environment with THEMIS", EUCASS-CEAS Conference 2023, 9-13 Jul. 2023, Lausanne.

[5] Cecilia Lanfredi Alberti, "Advancing the General Space Sustainability. OneWeb Commitment and Light Pollution



	and Active Debris Removal Indices Integration in SSR". 2023, Politecnico di Milano.
<b>Educational objectives</b>	The objective of this PhD is to develop skills in the modelling of space debris and in the control of the space environment. Through this PhD project the candidate will develop skills in mathematical development, simulations, programming (Matlab, Python). Soft skills in presenting the research, writing reports, outreach, dissemination, and preparing industrial progress meetings will be also achieved through the PhD project. For further information on the project visit: <a href="http://www.compass.polimi.it">www.compass.polimi.it</a>
<b>Job opportunities</b>	Job opportunities after a PhD on this topic can be in any of the space agencies, in particular the European Space Agency and the several European companies involved in space traffic management, space situational awareness, space policies and mission design.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 1 Assistant Professors 13 PhD Students
<b>Name of the research directors</b>	Camilla Colombo

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	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.