



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 38th cycle

PARTENARIATO PNRR Research Field: ROBUST CONTROL OF THE SPACE DEBRIS POPULATION

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 privatisation of Space and the Space Economy led to an increase in the number of orbiting objects in space. As the number of launches increases, as well the number of space debris objects in space is following exponential growth. Many sources cause the creation of new debris, such as launcher upper stages, satellite failures, inoperative satellites left in orbit at the end of life, fragments from in-orbit explosions and collisions, etc. 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's biosphere. As such, the 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. The mitigation of space debris requires the active control of its population and the definition of feedback action onto it. Models of the overall population on the other side need powerful tools of high-performance computing due to the very high dimensional problem and advanced formulation of the dynamics to integrate their evolution in a stable and efficient manner.

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

This Ph.D. research is part of the GREEN SPECIES project. In this we will model the dynamical evolution of space debris as a dynamical system, considering the accurate definition of all the sources, sinks of the space debris population, and the underlying dynamics of orbit



	<p>debris population, and the underlying dynamics of orbit perturbations. The density of space debris objects in the space of the orbital elements will be used as an adjoint variable. The continuity equation will be applied for the first time to an N-dimensional space debris environment to directly output the space debris density time history for a given orbital shell. Then we will implement robust feedback control techniques for the space debris problem. The analysis of transient and asymptotic behaviour of the complex dynamical system as such will be performed to reveal its sensitivity to sources, sinks, and control parameters. Robust control techniques will be devised to account for model, processes, and parameter uncertainties and to account for uncertainties in the prediction of economic and policy nature. HPC will be employed thanks to the participation of the HPC national centre.</p>
Educational objectives	<p>The objective of this Ph.D. is to develop skills in the modelling of space debris and in the control of the space environment. Through this Ph.D. project, the candidate will develop skills in mathematical development, simulations, and programming (Matlab, Python). Soft skills in presenting the research, writing reports, outreach, dissemination, and preparing industrial progress meetings will also be achieved through the Ph.D. project. For further information on the project visit: www.compass.polimi.it</p>
Job opportunities	<p>The Job opportunities that this project opens are in the field of mission analysis and trajectory design and long-term orbit propagation for space debris mitigation. During the Ph.D., collaborations will be made with the European Space Agency.</p>
Composition of the research group	<p>0 Full Professors 1 Associated Professors 1 Assistant Professors 7 PhD Students</p>
Name of the research directors	<p>Prof. Camilla Colombo</p>

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	2100.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The Ph.D. candidate will receive a desk and a personal computer. Apart from the compulsory ones, the Ph.D. candidate will have the opportunity to follow additional courses, receive economic support to attend summer schools, and participate in conferences. There will be the possibility of paid teaching assistantship. The Ph.D. will also contribute to the COMPASS group activities</p>