



**POLITECNICO**  
MILANO 1863

## Supervisor Expression of Interest MSCA-IF Marie Sklodowska Curie Action-Individual Fellowship 2020

<b>Supervisor name:</b>	Camilla Colombo
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Link pagina docente:	<a href="http://www.compass.polimi.it">www.compass.polimi.it</a>
Department Name: Research topic: ( <a href="https://www.polimi.it/en/scientific-research/research-at-the-politecnico/departments/">https://www.polimi.it/en/scientific-research/research-at-the-politecnico/departments/</a> )	Department of Aerospace Science and Technology 1. Earth Observation and Space Exploration 2. Complex aerospace systems  PE8_1. Aerospace engineering PE8_4. Computational engineering PE1_19. Control theory and optimisation
MSCA-IF Research Area Panels	<input type="checkbox"/> CHE_Chemistry <input type="checkbox"/> ECO_Economic Sciences <input type="checkbox"/> ENG_Information Science and Engineering <input type="checkbox"/> ENV_Environmental and Geosciences <input type="checkbox"/> LIF_Life Sciences <input type="checkbox"/> MAT_Mathematics <input type="checkbox"/> PHY_Physics <input type="checkbox"/> SOC_Social Sciences and Humanities
Politecnico di Milano Areas:	<input type="checkbox"/> Cultural Heritage <input type="checkbox"/> Smart Cities <input type="checkbox"/> Territorial Fragilities <input type="checkbox"/> Health <input type="checkbox"/> Industry 4.0 <input type="checkbox"/> Horizon Europe
Brief description of the Department and Research Group (including URL if applicable):	The COMPASS (“Control for Orbit Manoeuvring through Perturbations for Application to Space Systems”) group is part of the Space Mission Engineering Laboratory of the Department of Aerospace Science and Technology. The research focus of the group is on mission analysis enhances by the leveraging of natural forces perturbation through spacecraft manoeuvres for applications to 1) space transfer design and optimisation for small satellites and large constellations, 2) space debris modelling and remediation, 3) mission to asteroid for orbit manipulation and material exploitation, 4) planetary protection. For further info: <a href="http://www.compass.polimi.it">www.compass.polimi.it</a>



<p><b>Brief project description:</b> (max 1 page)</p>	<p><b>Towards space traffic management: assessment of Space congestion and capacity for control.</b></p> <p>In the likely future scenario of an increased number of objects in space, boosted by the non-adherence to the existing space debris mitigation guidelines and the increasing number of small satellites and large constellation launched, schemes for space traffic control will be required. Such a scheme, likewise air traffic and road traffic management procedures, will be based on a set of rules to define priorities and duties of the operating vehicles, with the additional challenge that within space traffic not all the objects are operational. Exploiting synergies with the existing schemes for air and road traffic management, this research project will perform the following research tasks:</p> <ul style="list-style-type: none"><li>▪ Space congestion orbital areas will be defined based on the analysis of the whole population evolution (alike congestion areas in cities and air routes);</li><li>▪ Environment indexes to quantitatively assess and compare those areas will be designed based on the spatial density of space debris and the accident that could occur in the case one collision or explosion would occur in each zone. In this framework the concept of environmental capacity will be used, seen as the typology and orbital regime of artificial space objects compatible with the stable evolution of the environment overall.</li><li>▪ Mission indexes to quantitatively assess the affect that one mission has on such an environment based on its potential for occupying a region of space, its potential to be the subject of an explosion or collision (depending on its system reliability and survivability in orbit and its collision avoidance manoeuvring capability), the ground casualty risk in case of an end-of-life re-entry. Such models depend both on the orbital region but also on the spacecraft characteristics.</li><li>▪ Based on the development of environment index, mission index and space congestion orbital areas, considering also spacecraft/mission characteristics, operational criteria will be defined for future space traffic management including: end-of-life disposal of space missions, orbit change (i.e. rerouting) of spacecraft, collision avoidance manoeuvre priority listing, toll system for space.</li><li>▪ An algorithm will be drafted for defining priorities list for spacecraft and traffic guidelines for control of their routes on the large scale. A web-based application will be delivered.</li><li>▪ Test cases will be defined in cooperation with satellite operators.</li></ul>
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