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Supervisor Expression of Interest

MSCA - Marie Skłodowska Curie Action - (PF)

Postdoctoral Fellowship 2025

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Department Name: Department of Aerospace Science and Technology

Research topic:

MSCA-PF Research Area Panels:

- ECO_Economic Sciences
- ENG_Information Science and Engineering**
- ENV_Environmental and Geosciences
- LIF_Life Sciences
- MAT_Mathematics
- PHY_Physics
- SOC_Social Sciences and Humanities
- CHE_Chemistry

Brief description of the Department and Research Group (including URL if applicable):

The Department of Aerospace Science and Technology (**DAER**) of Politecnico di Milano (**PoliMI**) is the largest Italian university department fully dedicated to aerospace research. PoliMi is within Top 9% of QS World University Rankings 2024 and 7th University worldwide on the Subject Engineering -Mechanical, Aeronautical & Manufacturing.

The **COMPASS** (Control for Orbit Manoeuvring through orbit Perturbation for Application to Space Sustainability) lab at PoliMi's DAER is committed to advancing methods and technologies for a sustainable use of the space system. COMPASS is led by Prof. Camilla Colombo and it is composed of 15 researchers (1 full professor, 1 associate professor, 1 assistant professor, 1 Post-doc fellow, and 11 PhD students). Activities span from basic and applied research in the field of mission analysis, prediction of debris population evolution, collision avoidance manoeuvring, and guidance navigation and control for multi-satellite missions. The team is involved in several research and industrial projects. For more information, visit <https://www.aero.polimi.it/it/laboratori-scientifici/compass-control-for-orbit-manoevring-through-orbit-perturbation-for-application-to-space-sustainability> and <https://www.compass.polimi.it/>.

TITLE of the project:

Distributed missions to enable innovative space services and sustainable use of space.

Brief project description:

Space services benefit social and economic development of mankind. The long-term sustainable exploitation of the outer space calls for the design of space systems compliant with high level of operational safety and proper implementation of end-of-life mission disposal.

Distributed Space Systems (DSS) may enable technological applications of scientific and societal relevance when standard monolithic solutions fail. Multi-satellite missions, swarms, and fractionated systems are key assets to build extended, flexible, and scalable space endeavours. Possible applications range from distributed sensors for Earth observation, distributed sensors for space observation, formation-flying missions around small bodies, and on-orbit-servicing, assembly, recycle and debris removal technologies.

The objective is to conceive an innovative space service/instrument that leverage the DSS architecture. The feasibility of such mission concept will be assessed by investigating the following themes (T).

T1. *Development of relative GNC (guidance navigation and control) algorithms*, to support the relative navigation and the establishment and maintenance of the required relative configuration between the elements of the DSS. The relative GNC system entails all the functions that complement the standard orbit/attitude determination and control functions of single-satellite missions. The typology of the algorithms implemented in such relative GNC systems depends on the geometry of the configuration (e.g., range, orbital environment) as well as on the structure of the architecture (e.g., level of cooperation/collaboration among the units, level of autonomy of the system).

T2. *Management of the safety of the DSS*, in terms of collision avoidance monitoring and manoeuvring. Multi-satellite systems require a special treatment of element-element collision avoidance compared to the standard methodologies applied to single-satellite missions encountering an external satellite or debris. This is mainly due to the different time scales of the encounters and to the possible use of relative trajectories that are not passively safe. The safety management involves different layers of the system, namely: the sensing sources providing observations, the algorithms to assess the collision risk, the strategy to (actively) ensure collision avoidance, and the hierarchy/priority of protective measures to ensure collision avoidance during operations.