PhD in
Aerospace Engineering

Description of the PhD Programme

The PhD program in Aerospace Engineering aims at the acquisition of the high level competence in the aerospace field required to carry out innovative research and/or advanced applications in universities, industries, public or private research centers, service companies. The level of the course allows the graduates to compete in a European and international environment. Over the years the PhD students have developed researches relevant to aircraft, rotorcraft and space applications, but also to technical areas not strictly related to the aerospace field. Example of PhD thesis topics are in:

- Computational and experimental fluid mechanics.
- Aeroservoelasticity, dynamic and control of aerospace structures.
- Flight mechanics and flight control.
- Passive structural safety of both aerospace and non-aerospace vehicles.
- Space missions analysis and design.
- Orbital mechanics and control
- Space debris
- Planetary protection
- Space situation awareness
- Innovative materials and structures design and testing.
- Advanced rotors
- Mathematical modelling and simulation
- Airworthiness and certification
- Space propulsion
- Wind turbines

The PhD program is hosted at the Department of Aerospace Science and Technology of Politecnico di Milano.
Director of the PhD course: Prof. Luigi Vigevano

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Info about program rules are available at the following web-page:
http://www.dottorato.polimi.it/en/during-your-phd/regulations/

PhD in Aerospace Engineering

Research Area n. 1 - Aerospace Engineering

Specific Research Subject: Space debris and small satellites constellation evolution model through density approach

Scholarships and Financial support – Departmental scholarships	
Monthly net income of PhD scholarship (max 36 months)	€ 1.200,00
Number of scholarships	1
Deadline for applications	15/09/2016
Beginning of PhD	01/11/2016
Context of the research activity	
Motivations and objectives of the research in this field	The space surrounding our planet is densely populated by an increasing number of man-made space debris, most of which have been generated from the break-up of operational satellites, abandoned spacecraft or upper stages of launchers. Space debris is internationally recognised as a hazard to current and future space activities and space agencies are currently cooperating to identify appropriate and sustainable space debris mitigation measures. The goal of this research is to develop efficient techniques to propagate the long term evolution of space debris and large constellations of small satellites and to provide with a fast and robust method to assess the criticality of explosion and collision events in orbit, the effects of large constellations of small satellites on the global population of space objects and the risk on current and future operating satellites due to the hazard of collision with space debris objects.
Methods and techniques that will be developed and used to carry out the research	The research proposed will develop methods for the fast and accurate modelling of the evolution of large clouds of debris fragments, population of space debris and constellation of large number of small spacecraft based on their spatial density. As demonstrated by previous research at the University of Southampton, the modelling of debris clouds through a continuum approach is an efficient way to propagate the density of particles in the space of orbital elements. A model of the whole population of space debris in all orbital regions (i.e., Low-to-Medium Earth Orbit, Geostationary and Geostationary Transfer Orbit) will be developed, to describe their density evolution and evaluate the risk of collision on current and future operating spacecraft. The continuity equation together with grid methods and Taylor differential algebra techniques will be employed for the density description and semi-analytical techniques, implemented in the PlanODyn tool, will be used for describing the long term orbit evolution. The method will be applied to assess the criticality and risk for space missions and their end-of-life phase based on their interaction with space debris and the risk of future fragmentation events. The density model developed will be also applied to describe the deployment, evolution, and performances of large constellations of small satellites. Analytical, numerical and programming skills are required.
Educational objectives	The main educational objectives concern the achievements of capabilities in the development of techniques for trajectory propagation and statistics for space debris studies. These skills include numerical methods, orbital dynamics, parallel programming, statistics and optimisation. The candidate will also spend period of research visit at the European Space Agency in ESOC Darmstadt, applying the developed tool to current and planned space missions.
Job opportunities	Job opportunities are identified in the fields of mission analysis, flight dynamics, navigation, space situation awareness, control engineering.
Composition of the research group	Number of Full Professors: 1 Number of Associate Professors: 3

	Number of Assistant Professors: 3
Names of the research director	Dr. Camilla Colombo
E-mail address, phone number and web-page	camilla.colombo@polimi.it
List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research	1. European Space Agency 2. The University of Southampton
Additional support	
Educational activities: financial aid per PhD student per year	1st year: max € 0 per student 2nd year: max € 1370 per student 3rd year: max € 1370 per student Additional travel funding are available within the research group.
Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student	There is the possibility to get financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.
Computer availability:	Individual personal computer and access to world-class high-performance computing, if necessary.
Desk availability:	1st year: *individual use* 2nd year: *individual use* 3rd year: *individual use*