

# 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.

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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/>

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### Specific Research Subject: Orbit determination of resident space objects using radar sensors in multibeam configuration

<b>Scholarships and Financial support – Departmental scholarships</b>	
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
<b>Context of the research activity</b>	
Motivations and objectives of the research in this field	Near-Earth space has become progressively more crowded in active satellites, inactive spacecraft and debris. Consequently, an international effort is currently being devoted to improving the performance of optical and radar sensors for space objects monitoring. Within this framework, this research activity will focus on the development of algorithms for orbit determination of resident space objects using radar sensors in multibeam configuration. The algorithms shall be tailored to processing data from the Northern Cross radiotelescope located in Medicina (Bologna, Italy). In addition, the algorithms shall solve the initial orbit determination of unknown objects as well as the orbit refinement of known objects from a consolidated database.
Methods and techniques that will be developed and used to carry out the research	To achieve the aforementioned objectives, the research will develop methods to address the following major points: <ul style="list-style-type: none"> <li>• the right ascension and declination profiles shall be determined from the SNR profiles of the sensor</li> <li>• ranging shall be added by reproducing the actual sequential use of the ranging and tracking modes within the passage of the object in the field of view of the sensor</li> <li>• different orbit determination algorithms shall be developed and compared to determine the orbit of the object and the associated statistics</li> <li>• the multibeam configuration and the orbit determination algorithms shall be optimized to maximize the accuracy of the orbit determination process, reduce the associated uncertainty, and minimize the orbit determination failures</li> <li>• an observation scheduler shall be developed to schedule new observations of the observed objects, taking into account the effect of the nonlinear propagation of the statistics</li> <li>• the algorithms shall be extended to estimate the radar cross section and the ballistic coefficient during orbit determination refinement</li> <li>• the developed algorithms shall be validated by numerical simulations and with dedicated experimental campaigns</li> </ul>
Educational objectives	The main educational objectives concern: <ul style="list-style-type: none"> <li>• building a substantial background on classical and advanced methods for orbit determination of resident space objects</li> <li>• achieving a wide-ranging knowledge on the topic of space surveillance and tracking (SST), including awareness of its main challenges</li> <li>• developing substantial capabilities on the management of an innovative sensor to monitor and track resident space objects</li> </ul>
Job opportunities	The proposed research work will develop in parallel to the launching of the European SST Support Framework. The Northern Cross radiotelescope of Medicina is among the sensors included in the EU SST Framework. Consequently, the PhD candidate will have the opportunity to become a future expert in the SST field and to find job opportunities in the EU SST system.
Composition of the research group	Number of Full Professors: 1 Number of Associate Professors: 3 Number of Assistant Professors: 3
Names of the research	Dr. Pierluigi Di Lizia

director	
E-mail address, phone number and web-page	pierluigi.dilizia@polimi.it
List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research	<ol style="list-style-type: none"> <li>1. Istituto Nazionale di Astrofisica (INAF)</li> <li>2. Italian Space Agency (ASI)</li> <li>3. University of Malta</li> </ol>
<b>Additional support</b>	
<u>Educational activities:</u> financial aid per PhD student per year	<p>1<sup>st</sup> year: max € 0 per student                  2<sup>nd</sup> year: max € 1370 per student                  3<sup>rd</sup> year: max € 1370 per student</p> <p>During eventual research periods spent abroad the monthly scholarship will be increased by approximately 50%                  Additional travel funding are available within the research group.</p>
<u>Teaching assistantship:</u> 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.
<u>Computer availability:</u>	Individual personal computer and access to world-class high-performance computing, if necessary.
<u>Desk availability:</u>	<p>1<sup>st</sup> year: <i>individual use</i>                  2<sup>nd</sup> year: <i>individual use</i>                  3<sup>rd</sup> year: <i>individual use</i></p>