



# PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

**PNRR 630 Research Field: MATURATION OF STRUCTURED ROBUST FLIGHT CONTROL DESIGN**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1500.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>Helicopters are reliable systems for diverse mission-critical applications, from search and rescue operations to military and civilian transportation. Ensuring the safety and effectiveness of these versatile aerial platforms is of paramount importance. However, the complexity of rotorcraft dynamics introduces significant model uncertainties that can have far-reaching implications.</p> <p>To address this critical need, the research focuses on the development of structured robust design methodologies for flight control laws. These approaches will account for the inherent uncertainties in rotorcraft models, enhancing safety and performance. By tackling the challenge of model uncertainty and improving flight control laws, we aim to increase the adaptability and reliability of helicopters, making them more capable across a wide range of conditions and mission profiles.</p> <p>By advancing our understanding of rotorcraft dynamics through the development of structured robust control laws, the research seeks to bolster the safety and effectiveness of helicopters, benefiting various industries and applications that depend on these aerial platforms.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	The main objective is the maturation of structured robust flight control law design methods. Starting from the



	<p>flight control law design methods. Starting from the analysis of the capability of the well-known NASA Conduit tool, advanced control frameworks that explicitly account for identified uncertainties and are tailored to the multivariable nature of helicopter systems will be developed. These frameworks shall ensure system stability and maintain desired performance levels in the presence of uncertainty. Furthermore, the integration of nonlinear analysis and synthesis methods that can effectively manage the presence of nonlinear components within the helicopter's dynamics will be considered.</p>
<p><b>Educational objectives</b></p>	<p>The specific objective of this PhD is to develop skills in the design, implementation and deployment of rotorcraft flight control systems. Through this project, the candidates will develop a broad range of skills not only in mathematical modelling, simulation, algorithm design and implementation, but also in the design, optimisation, and flight-testing of flight control laws. The multidisciplinary nature of the proposed research and the cooperation with an industrial partner will allow the candidate to mature an attitude open to innovation and exchange between the research and industrial worlds. Education will be complemented by a broad variety of soft skills, including presentation of the research, report writing, outreach, dissemination, and preparation of industrial progress meetings.</p> <p>The proposed activity is interdisciplinary in nature; therefore the candidate shall pursue during the course of the PhD program a study plan suitable to complete her/his background with respect to the goals of the research. This will be made possible by suitable choices of courses from the Aerospace Engineering and the Information Engineering PhD program.</p>
<p><b>Job opportunities</b></p>	<p>The job opportunities that this project opens are in the field of the design and operation of advanced flight control systems in the aerospace industry. The rotorcraft field is expanding at a very fast rate and it is expected that the introduction of new technologies such as the ones which will be studied in the framework of the proposed research will further enlarge the spectrum of possible applications.</p>



	In this respect specialists in the design and operation of advanced flight control systems will have a very appealing job profile.
<b>Composition of the research group</b>	1 Full Professors 0 Associated Professors 1 Assistant Professors 5 PhD Students
<b>Name of the research directors</b>	Prof. Marco Lovera

<b>Contacts</b>	
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156 Milano - Italy +390223998323 - email: <a href="mailto:phd-daer@polimi.it">phd-daer@polimi.it</a> web: <a href="https://www.aero.polimi.it/">https://www.aero.polimi.it/</a>	

<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	750.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Leonardo Helicopter Division
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	TU Delft
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>	
The PhD candidate will receive a desk, possibly through a hot-desking procedure, and a personal computer, if needed. Apart from the compulsory ones, the PhD candidate will have the opportunity to follow additional courses and receive economic support to attend summer schools and participate in conferences. There will be the possibility of paid teaching assistantship.	