



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

PNRR 630 Research Field: MATURATION OF MODEL IDENTIFICATION FOR ROTORCRAFT DYNAMICS

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

Context of the research activity	
Motivation and objectives of the research in this field	<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>Accurate modelling is a cornerstone of safe and efficient rotorcraft operations. These models underpin the development of precise and reliable flight control systems, contributing to enhanced performance, safety, and cost reduction. In the context of rotorcraft dynamics, it is imperative to address model uncertainties comprehensively, as they can originate from a multitude of sources.</p> <p>To address this critical need, the research focuses on the development of advanced model identification techniques for rotorcraft dynamics. These approaches will account for the inherent uncertainties in rotorcraft models, enhancing safety and performance. By tackling the challenge of model uncertainty, 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 accurate modeling the research seeks to bolster</p>



	<p>the safety and effectiveness of helicopters, benefiting various industries and applications that depend on these aerial platforms.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The objective involves the development and refinement of advanced techniques to characterize and quantify model uncertainties in the dynamic behaviour of rotorcraft, with particular emphasis on understanding the multivariable nature of helicopter systems. Additionally, the identification and modelling of concentrated nonlinear components within the rotorcraft system, such as backlash in mechanical linkages, hysteresis in actuators, and various aerodynamic nonlinearities will be addressed. Finally, probabilistic models to better represent uncertainties, including their statistical distribution will be developed.</p>
<p>Educational objectives</p>	<p>The specific objective of this PhD is to develop skills in the design, modelling, and simulation of rotorcraft flight dynamics. 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 design, optimisation, and flight testing.</p> <p>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>



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

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

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

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



Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

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.