POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 39th cycle

PNRR 118 PA Research Field: DEVELOPMENT OF TOOLS FOR THE DESIGN AND CERTIFICATION-BY-SIMULATION OF ADVANCED AIR MOBILITY POWERED LIFT AIRCRAFT

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 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	Powered lift aircraft represent an extremely promising solution for the emergent and novel field of advanced air mobility (AAM), to expand the versatility of air transportation, minimize door-to-door travel time, and reduce road and main airport congestion with direct and indirect beneficial consequences on pollution. The design of AAM and electric Vertical Take-Off and Landing (eVTOL) vehicles, especially in the early stage, is significantly more demanding with respect to conventional fixed and rotary-wing aircraft, especially since there are new configurations, lift and propulsion concepts – the related operating conditions and associated loads - force designers to operate outside of their “comfort zone” and rely more on numerical modelling techniques. The development of accurate, complete and efficient virtual prototypes is fundamental to reducing development costs, time to market, and the risk associated with making sub-optimal choices early in the design phase. Furthermore, AAM vehicles will be requested to demonstrate compliance with requirements that are constantly evolving, since the certification authority is also developing them alongside the development of the first vehicle prototypes. It is thus of paramount importance for OEMs to rely on efficient numerical simulations that can support – and in some cases supplant – the flight testing operations. For this reason, the potential flight envelope of these vehicles needs to be explored in a virtual

	environment, critical mission profiles need to be detected, along with their potential impact on sizing conditions and loads. The result will be the foundational part of the digital thread that encompasses the lifecycle of future advanced air mobility vehicles through their digital twin.
Methods and techniques that will be developed and used to carry out the research	The candidate will first develop the skills required to perform the project, building on pre-existing competencies of structural mechanics, dynamics, aeroelasticity, and related mathematical methodologies. The training will be completed by the familiarization with the EU documents related to AAM certification and operation, in particular, “Means of Compliance with the Special Condition VTOL”, recently released by EASA, and ED-295, "Guidance on VTOL Flight Control Handling Qualities Verification" to be released from EuroCAE. Key aspects like the expected manoeuvres, especially those associated with vehicle reconfiguration and transitional flight (for example, in the case of tilting rotors/wings or reconfigurable control surfaces) will be identified, parameterized, and classified in terms of required performances and impact on operational requirements and resulting internal loads. Comprehensive aeromechanical simulations of incremental fidelity will be set up, including structural dynamics and interactional aerodynamics, suitably correlated with currently available and foreseeable experimental data, to extract design guidelines and indications, also in support of the needs of a future certification process. Special focus will be placed on the development of models and tools for real-time pilot-in-the-loop simulation, with the aim of supporting best practices in the certification-by-simulation process. At least basic competencies in structural dynamics, aeroelasticity, and computer programming are strongly recommended.
Educational objectives	The candidate will develop specific skills related to structural dynamics, aeroelasticity, rotor aeromechanics, and computational methods, including those specifically aimed at pilot-in-the-loop real-time simulation and in general the disciplines that characterize advanced vertical take-off aircraft and powered lift air vehicles, along with the current status and the foreseen trends in powered lift

	vehicles certification and operation. In addition, by working in a mixed and vibrant academic and industrial context, the candidate will have the opportunity to learn on the job several transferable skills, including communication skills, team working, leadership, and ethical aspects associated with the use of innovative technologies. In support of this, the PhD School of Politecnico di Milano provides a complete and rather diverse offer of courses. Each candidate must include in their syllabus at least 10 ECTS in transferable skills, to complement at least other 5 ECTS in technical disciplines associated with Aerospace Engineering, for a total of at least 20 ECTS.
Job opportunities	The candidate finds natural application in the national, European, and worldwide aerospace industry in a sector that promises strong expansion and therefore requires strong competitiveness to maintain the top-level role that the national industry currently occupies. However, they also find application in numerous other high-tech industrial fields, in which dynamics, aeromechanics, optimization, computational methods, and the integration of complex systems play a fundamental role, centred on but not limited to industrial engineering.
Composition of the research group	2 Full Professors 0 Associated Professors 1 Assistant Professors 8 PhD Students
Name of the research directors	Pierangelo Masarati

Contacts
FRAME-Sim Laboratory, Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano - Italy +390223998309 - email: pierangelo.masarati@polimi.it - web site: http://www.aero.polimi.it

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	TXT Group
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	NLR (NL)
By number of months abroad	6

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

The project will be in cooperation with TXT Group, with internships and continuous interchange of information and evaluation of the progress, within a broader collaborative area including Leonardo Helicopter Division, Kopter, emerging AAM manufacturers, research centres like NLR (where an internship is planned) and DLR, and universities like TU Delft, the University of Liverpool, Cranfield, Aachen, RMIT, and ZHAW.

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.