



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 38th cycle

**PNRR_352 Research Field: APPLICATION OF MULTI-DISCIPLINARY OPTIMIZATION TO
THE DESIGN OF POWERED-LIFT AIR VEHICLES**

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

Funded by PNRR M4C2 (dalla ricerca all'impresa)
Contributes to M1C2 (digitalizzazione, innovazione e
competitività nel sistema produttivo)

Powered-lift aircraft represent an extremely promising
solution for advanced air mobility, 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.

However, their design is expected to be significantly more
demanding than that of conventional fixed and rotary-wing
aircraft, because new configurations, lift and propulsion
concepts need to be considered, outside of the comfort
zone of more conventional designs.

For this reason, it is of utmost importance to consider as
early as possible their several characteristic disciplinary
aspects during design, by blending existing, well-proven
disciplinary design methodologies with innovative
approaches in a multi-disciplinary optimization (MDO)
framework, leveraging distributed and high-performance
computing environments and open software architectures.
The focus of the research is on the development of an
architecture capable of performing MDO on innovative
configurations in terms of the number and type of lifting
surfaces, rotors, means of propulsion, operational
capabilities, and performance requirements. The result
will be the foundational part of the digital thread that
encompasses the lifecycle of future advanced air mobility



	<p>vehicles through their digital twin.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Period abroad: 6 months, Rotorcraft Center of Excellence, Pennsylvania State University, USA Internship: 6 months, Leonardo Helicopters</p> <p>The candidate will first develop the skills required to perform the project, building on pre-existing competencies of structural mechanics, dynamics, aeroelasticity, and the related mathematical methodologies.</p> <p>The modeling methodologies currently in use for each discipline will then be evaluated, to identify suitable integration paradigms that guarantee the modularity of the approach, and novel methods for specific innovative aspects (methodological, e.g., mesh morphing, shape optimization, neural-network-based metamodels, and technological, e.g. electric propulsion, low- and mid-fidelity multi-rotor interaction analysis) will be integrated.</p> <p>The developed and integrated methodologies will be tested on problems of increasing complexity and innovativity, to leverage the existing knowledge base for their assessment.</p> <p>At least basic competencies in structural dynamics, aeroelasticity, computer programming, and high-performance computing are strongly recommended.</p> <p>A 6-month period abroad is planned, at the Pennsylvania State University, USA, at their Rotorcraft Center of Excellence.</p>
<p>Educational objectives</p>	<p>The candidate will develop specific skills related to structural design, dynamics, aeroelasticity, rotor aeromechanics, multi-disciplinary optimization, computational methods, high-performance and distributed computing, and in general of all disciplines that characterize advanced vertical take-off aircraft and powered lift air vehicles.</p> <p>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 Ph.D. School of</p>



	<p>Politecnico di Milano provides a complete and rather diverse offer of courses.</p> <p>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.</p>
Job opportunities	<p>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, centered on but not limited to industrial engineering.</p>
Composition of the research group	<p>2 Full Professors 0 Associated Professors 1 Assistant Professors 8 PhD Students</p>
Name of the research directors	Prof. Pierangelo Masarati

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	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)	Leonardo Helicopters
By number of months at the company	6
Institution or company where the	Rotorcraft Center of Excellence, Pennsylvania State University, USA



candidate will spend the period abroad (name and brief description)	
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The project will be in cooperation with Leonardo Helicopter Division, with an internship of at least 6 months and continuous exchange of information and evaluation of the progress. There will be the opportunity for a period of study and research abroad of at least 6 months.</p> <p>The Ph.D. candidate will receive a desk and a personal computer if needed. Apart from the compulsory ones, the Ph.D. 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.</p>