POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

Number of scholarship offered	5
Department	DIPARTIMENTO DI SCIENZE E TECNOLOGIE AEROSPAZIALI

Description of the PhD Programme

The Ph.D. course in Aerospace EngineeringÂ provides the high-level competence in the aerospace field required to carry out innovative research and advanced applications in universities, industries, public or private research centers, and service companies. The Ph.D. programÂ emphasizes the development of multi-disciplinary thinking and problem-solving skills in students, withÂ particular attentionÂ toÂ the potential environmental and societal impact of the research, while striving to give the students a solid knowledge of the fundamental physical phenomena and all necessary state-of-the-art methods and tools. The course level allows the graduates to compete in a European and international environment. Over the years, the Ph.D. students have developed research relevant to aircraft, rotorcraft, and space applications and technical areas not strictly related to the aerospace field. Examples of Ph.D. thesis topics are Computational and experimental fluid mechanics, Aeroservoelasticity, Dynamics and Control of Aerospace Structures, Flight Mechanics and Flight Control, Passive Structural Safety of Aerospace and Non-Aerospace Vehicles, Space Missions Analysis and Planning, Innovative Materials and Structures Design and Testing, Space Propulsion, Wind Turbines, Advanced Rotorcraft Technologies, Maintenance-Based Design, Mathematical Modelling and Simulation, Airworthiness and Certification.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: ADVANCED MATERIALS AND TECHNOLOGIES

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	The success of future aerospace structures will depend on their multi-functionality. Their efficiency will depend on their capability of integrating different features (e.g., structural performances, thermal endurance, and morphing capabilities). Their durability and sustainability will depend on the capability of self-monitoring, self-healing, and to the possibility of recycling/reuse, respectively. Their affordability will depend on the capability of incorporating HUMS (health and usage monitoring systems) for implementing predictive maintenance approaches. Besides, advanced manufacturing technologies, including additive ones, will enable the integration, reliably and profitably, of all these characteristics into aerospace structures. These are the general objectives in this research field and the focused targets of this specific research topic.
Methods and techniques that will be developed and used to carry out the research	The research will be carried out through a multi-tool numerical/experimental/technological philosophy, i.e., exploiting the synergy among innovative multiscale numerical approaches, actuating/sensing/healing strategies, and advanced production technologies (additive, out-of-autoclave).
Educational objectives	To develop the capability to design smart structures and assess related process techniques. To gain experience in

	managing multi-tools research approaches.
Job opportunities	Researcher with a broad background in fundamental disciplines including materials and manufacturing engineering, production process manager, and senior test engineer.
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 9 PhD Students
Name of the research directors	G. Sala, L. Di Landro, P. Bettini, A. M. Grande

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano - Italy giuseppe.sala@polimi.it (tel. +39 02 2399 8361)Â luca.dilandro@polimi.it (tel. +39 02 2399 8398) paolo.bettini@polimi.it (tel. +39 02 2399 8391) antoniomattia.grande@polimi.it (tel. +39 02 2399 8369)

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.


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PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: AEROELASTICITY, VIBROACOUSTICS AND CONTROL OF STRUCTURES

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	The ability to model, simulate and control aeroservoelastic phenomena is a key factor for the successful design of many light structures. Reduction of transmitted vibrations and noise emission, either by means of active or passive solutions, is another extremely challenging engineering problems. Goal of the project is the development of new multidisciplinary modeling techniques and control methods. Possible fields of research include: development of advanced aeroservoelastic models, improvement of the control efficiency and effectiveness of multidisciplinary aeroservolelastic design and optimization techniques, the improvement of vibration transmission and noise emission modeling and control.
Methods and techniques that will be developed and used to carry out the research	Many methods and techniques may be developed and used. Among them: aerodynamic high fidelity models and reduced order simulation techniques; robust, scheduled-adaptive, linear-nonlinear control design; Statistical Energy Analysis, Wave-based approaches, advanced Finite Elements, improved analytical and semi-analytical structural models; development of damping materials constitutive laws and experimental identification of constitutive laws parameters; design and optimization of acoustic metamaterials; robust design of damping systems and vibrating machinery; hierarchical, multidisciplinary modeling of massively actuated fluid-elastic systems; design of centralized and decentralized distributed control systems.

	distributed control systems.
Educational objectives	The student is expected to acquire multidisciplinary competences in some of the following research fields: aeroservoelastic modeling and control, optimization, structural design, vibration modeling and control, sound transmission and material modeling. He will likely use and improve modular, possibly parallel and multidisciplinary simulation and optimization codes.
Job opportunities	The multidisciplinary competences required for these projects are valuable assets for a quick and successful employment. The above research fields are crucial for a wide range of engineering applications, including aerospace, automotive, civil and marine ones.
Composition of the research group	1 Full Professors 2 Associated Professors 0 Assistant Professors 3 PhD Students
Name of the research directors	M. Morandini

Contacts
marco.morandini@polimi.it; +39 02 2399.8362 lorenzo.dozio@polimi.it; +30 02 2399.8329

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: AEROSPACE SYSTEMS AND CONTROL

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	Aerospace engineering poses a formidable number of challenges in the systems and control area, both in view of the higher level of automation expected from flight vehicles and of the recent emergence of unmanned vehicles. Estimation and control systems design problems in aerospace are intrinsically challenging because of their multivariable, nonlinear nature, often associated with large model uncertainty and unstable dynamics. In view of this, the objective of the present research is to investigate, by means of a suitable combination of analytical and experimental methods, the main issues in the dynamics and control of full scale and small scale helicopters and multi-rotor aircraft, both manned and unmanned, ranging from single-vehicle attitude and position control to formation control and interaction with the environment (e.g., vehicle-to-vehicle and vehicle-to-infrastructure interaction, aerial manipulation).
Methods and techniques that will be developed and used to carry out the research	Combinations of first principle and experimental modelling; state estimation methods; robust, adaptive, nonlinear control; analysis and design in simulation; experimental work on small-scale vehicles in a dedicated laboratory.
Educational objectives	Understanding of the state of the art in systems and control methods; expertise in developing computational tools, and performing experiments; verification of developed methods via numerical simulation and

	experiments.
Job opportunities	Senior flight dynamicist; senior flight control engineer.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	Marco Lovera

Contacts
Marco Lovera: marco.lovera@polimi.it, (Tel.) +39-02-2399.3592, https://home.aero.polimi.it/lovera

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: AIRCRAFT CRASHWORTHINESS

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	The academic study of aerospace crashworthiness is driven by the need to enhance passenger safety and structural integrity under extreme loading conditions. With the growing adoption of lightweight composite materials, novel aircraft configurations (such as eVTOLs), and the rise of Urban Air Mobility, understanding energy absorption mechanisms during crashes is essential. Research in this area supports the development of predictive models and advanced testing of aircraft structural elements, as well as biomechanical models of the human body, to design safer and more resilient airframes in both current and future scenarios.
Methods and techniques that will be developed and used to carry out the research	Static and dynamic characterization of mechanical properties of materials and their fracture mechanics. Impact loads and crash tests on material specimens, coupons, and structural components. Advanced numerical methods, such as nonlinear explicit finite element modelling, lumped-mass multi body methods, fluid-structure interaction, neural networks, optimization, uncertainties assessment
Educational objectives	A PhD in aerospace crashworthiness builds expertise in impact mechanics, composite materials, and structural energy absorption. It combines experimental testing and advanced numerical modeling. Skills include damage assessment, crash simulation, and safety-driven design.

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Job opportunities	Structural Engineer, FEA Engineer, Crashworthiness Engineer
Composition of the research group	0 Full Professors 3 Associated Professors 3 Assistant Professors 4 PhD Students
Name of the research directors	P. Astori, Anghileri, Airoldi, Janszen, Caporale

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali â€“ Politecnico di Milano Via La Masa 43, 20156, Milano â€“ Italy paolo.astori@polimi.it marco.anghileri@polimi.it alessandro.airoldi@polimi.it gerardus.janszen@polimi.it antoniomaria.caporale@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

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PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: DEEP-SPACE ASTRODYNAMICS RESEARCH AND TECHNOLOGY

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	Motivated by a great scientific interest and unique potential of technological exploitation, the exploration of minor bodies and the cislunar space is escalating. Â Although safe and reliable, ground-based operations are inadequate to sustain a massive deep- and near-space exploration, due to cost and limited availability of ground stations. Also, a ground-in-the-loop approach introduces inevitably time delays, which in turn translates into flying inherently safe missions. This poses strong limitations to the envelop of activities that can be performed, thus dampening the vast potential of space scientific and technology tasks that could be performed.The objective of this research is to enable autonomous operations in deep-space and near uncooperative targets such as (but not limited to) minor bodies. The project ambition is to prove that dee-space operations can be performed in autonomy by a spacecraft, overcoming the current limitation given by the human-in-the-loop approach.
Methods and techniques that will be developed and used to carry out the research	The project methodology is structured on four main research lines. 1) Astrodynamics &Mission Design: The research aims at improving the state-of-the-art onmission analysis, trajectory optimization, and nonlinear astrodynamics. 2) Asteroid Science: The research involves asteroids origin and evolution, surface &particle dynamics, payload design.

	design. 3) Autonomous GNC: The research deals with autonomous guidance, autonomous navigation, verification &validation. 4) Digital and Physical Twins: The research is on MIL, SIL, PIL, and -HIL simulations, digital twins, science operations.
Educational objectives	The objective of this PhD research is to develop skills in space system modelling and simulation, space science, autonomous guidance, navigation, and control, as well as verification and validation. The candidate will gain relevant expertise in near-Earth and deep-space missions. Through this project, the candidates will develop skills in mathematical modeling, numerical analysis, computer programming (Matlab, Python, C++, or similar), and image processing. Moreover, the candidate will develop skills on both computer and processor/hardware-in-the-loop simulations. Soft skills in disseminating the research, writing reports, performing outreach, and preparing industrial progress meetings will be also achieved through the PhD project.
Job opportunities	The current research prepares the PhD candidate to both academic and industrial careers. Knowledge of model-based system engineering, modeling and simulation of space systems, space science, mission design and analysis, as well as autonomous guidance, navigation, and control are fundamental skills for careers in space-related companies and universities.
Composition of the research group	1 Full Professors 1 Associated Professors 10 Assistant Professors 26 PhD Students
Name of the research directors	Francesco Topputo, Fabio Ferrari

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano - Italy Phone: +39 02 2399 8351/7157 email: francesco.topputo@polimi.it-web site: www.aero.polimi.it or https://dart.polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

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PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: MULTIDISCIPLINARY DESIGN OPTIMIZATION OF PASSIVE, ACTIVE AND MORPHING AEROSPACE STRUCTURES

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	Optimal design of innovative aerospace structures aims to provide these kinds of structures the ability to adapt to mission requirements or external changes achieving near-optimal performances in multiple operating conditions. This approach needs specific design procedures combined with different technologies that can be combined with each other: passive structures that respond to external events without the need for active control systems; actively controlled structures that enable to extend the operational envelope or reduce the effects of external changes via a dynamic adaptation and the use of sensors and actuators; morphing structures which is a family of innovative structures related to the capability of continuously changing their external shape across the operational envelope, via a time-varying adaptation.
Methods and techniques that will be developed and used to carry out the research	To fully exploit all the potential benefits of innovative structures, it is requested to adopt Multidisciplinary Design Optimization (MDO) procedures, appropriately developed to consider advanced manufacturing technologies and multifunctional materials. The Ph.D. candidate will contribute to the development of such procedures as well as to the design and testing of experimental/wind tunnel demonstrators aiming at the validation of new concepts.
Educational objectives	Know-how in design optimization, structural dynamics, aerospace materials, and manufacturing. Expertise in

	developing MDO techniques and performing experimental/wind tunnel tests.
Job opportunities	Senior researcher with a strong background in fundamental disciplines, interaction across multiple disciplines, design methodologies, experimental/wind tunnel testing, and use of control and automation techniques. The above scientific skills cover a wide range of engineering applications and are strongly requested by industries, non-limited to the aerospace field.
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 2 PhD Students
Name of the research directors	S. Ricci, A. De Gaspari, A. M. Grande

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano â€“ ItalyÂ sergio.ricci@polimi.it (PH. +39 02 2399 8319) alessandro.degaspari@polimi.it (Ph. +39 02 2399 8368)Â antoniomattia.grande@polimi.it (Ph. +39 02 2399 8369)Â

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: NABUCCO - DESIGN, ANALYSIS AND TESTING OF AEROSPACE COMPOSITE STRUCTURES UNDER BUCKLING AND POST-BUCKLING REQUIREMENTS

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	The research activities aim to enhance the efficiency of future aircraft and space structures by implementing composite materials and innovative concepts. Some of these concepts are based on the smart utilization of buckling-driven solutions. Although structural buckling has traditionally been seen as a potentially dangerous issue to be avoided due to its association with catastrophic failure, the nonlinear behavior linked to this phenomenon could actually be advantageous in the current drive for more efficient structures.By exploiting controlled buckling, it would be possible to develop adaptive, morphing, and load-bearing structures capable of optimizing performance, reducing weight, and improving energy efficiency, enabling new possibilities where buckling is intentionally used as a functional mechanism rather than a structural limitation.
Methods and techniques that will be developed and used to carry out the research	We are exploring new methods for the design of composite structures combining numerical and analytical tools with experimental tests. These methods concern advanced techniques based on finite elements, machine learning techniques and analytical formulations, for robust and efficient solution of nonlinear problems, and the modelling of damage phenomena. In this framework, we investigate composite structures considering the new requirements of buckling and post-buckling for

	aeronautical and space applications.To ensure the accuracy and reliability of simulations, we complement numerical analysis by experimental tests. Composite structures are tested under various loading conditions to investigate their buckling and post-buckling performance. The test results allow to validate the simulation tools and to gain a deeper understanding of the structural behaviour under realistic operational conditions.
Educational objectives	The goal is to design, analyse and optimize aerospace composite structures through a multidisciplinary approach. Hence, the candidate will be exposed to both theoretical, numerical and experimental activities. Skills will be developed ranging from structural modelling to numerical competencies in finite element analysis, analytical formulations and machine learning techniques. The research activities require the candidate to contribute autonomously and innovatively, aiming to foster critical thinking, intuition, and problem-solving abilities.
Job opportunities	The knowledge gained can be applied across various sectors where lightweight structures play a significant role.The expertise developed, particularly in the field of numerical simulation and the development of new methods and models, is also valuable to organizations involved in technological development beyond the aerospace sector. The focus of the research also makes the candidate an ideal profile for a career in research and development.
Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 6 PhD Students
Name of the research directors	Chiara Bisagni, R. Vescovini, A. Raimondo

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali â€“ Politecnico di Milano Via La Masa 43, 20156, Milano â€“ Italy Chiara.Bisagni@polimi.it (tel. +39 02 2399 8344) Riccardo.Vescovini@polimi.it Antonio1.Raimondo@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

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PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: PHYSICAL FLUID 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	Research activities at the Physical Fluid Dynamics Laboratory (PFDL) are aimed at understanding fundamental issues arising in fluid flows operating at highly non-ideal conditions, including flows of rarefied gases, multi-phase and interfacial flows and the fluid dynamics of vapors close to the liquid-vapor saturation curve and critical point, using a comprehensive theoretical, experimental and numerical approach. The expertise in these research areas is a necessary requirement to tackle applications such as e.g. the aero-thermodynamics of re-entry vehicles, vacuum systems design, sustainable energy and flow processes in micro- and nano-devices.
Methods and techniques that will be developed and used to carry out the research	CFD techniques for non-ideal and multiphase fluids (Volume of Fluid, Diffuse Interface Models); Monte Carlo and Molecular Dynamics
Educational objectives	Matching macroscopic and microscopic approaches to achieve a deeper understanding of fluid behavior and improve modeling tools.
Job opportunities	Senior fluid dynamicist for energy, space and material science applications.
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 5 PhD Students

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Name of the research directors	M. Belan, A. Guardone

Contacts
marco.belan@polimi.it , +39-02-2399.8045 alberto.guardone@polimi.it, (Tel.) +39-02-2399.8393

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: PROPULSION

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	Aerospace propulsion research is driven by the need to design more efficient, sustainable, and high-performance systems to meet the growing demands of space exploration, commercial aviation, and defense applications.In *space propulsion*, the research aims at advancing propulsion systems for long-duration missions to Mars and beyond, as well as to enhance satellite maneuverability and lifespan.In *airbreathing propulsion*, efforts are focused on optimizing gas turbines and hybrid-electric engines to reduce fuel consumption and environmental impact.Main research challenges are here described. •Integration of alternative fuels, detonation-based propulsion, and green propulsion technologies to support the growing focus on sustainability, while driving advancements in airbreathing and rocket propulsion systems. •Experimental studies of solid combustion and energetic materials play a significant role in improving propulsion performance, particularly in high-temperature applications. Additionally, the development of novel propulsion components through new materials and additive manufacturing techniques, combined with computational fluid dynamics (CFD) simulations, enhances the accuracy of design predictions. •Research in hypersonic and high enthalpy flows for advanced propulsion technologies for hypersonic flight

	and deep space exploration focuses on understanding the extreme thermal and chemical environments encountered during high-speed flight and re-entry, crucial for designing efficient air-breathing and rocket engines.
Methods and techniques that will be developed and used to carry out the research	The research activity will integrate experimental techniques, modelling tools, and advanced CFD methods, preferably with open-source software, to investigate thermochemical rockets (solid, liquid, hybrid), plasma-based propulsion solutions, high-enthalpy/hypersonic propulsion, thermal protection systems, and reacting flows at all speeds.
Educational objectives	The PhD candidates will develop advanced expertise in propulsion system design and related energetics, performance optimization, advanced experimental diagnostics, and development of advanced simulation methods for reacting and high-enthalpy flows. The developed competences will be functional to address current challenges in hypersonic flows, combustion, and sustainability.
Job opportunities	Propulsion system engineer, propulsion R&D staff, CFD engineer, CFD methodologist, CFD software developer, combustion expert, high-enthalpy flow specialist, hypersonic researcher, CFD consultant.
Composition of the research group	1 Full Professors 2 Associated Professors 2 Assistant Professors 7 PhD Students
Name of the research directors	F. Maggi, F. Piscaglia, Paravan, Ghioldi, Carlotti

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, MilanoÂ - Italy - www.aero.polimi.it filippo.maggi@polimi.it, ph. +39 02 2399 8287 federico.piscaglia@polimi.it, ph. +39 02 2399 8620 christian.paravan@polimi.it, ph. +39 02 2399 8058 federico.ghioldi@polimi.it, ph. +39 02 2399 8014 stefania.carlotti@polimi.it, ph. +39 02 2399 7198

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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

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PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: ROTORCRAFT AERODYNAMICS

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	Rotorcraft aerodynamics is a very challenging subject, due to the coexistence of several physical features: unsteadiness, shocked flow, flow separation, complex vertical wakes, noise, and fluid/structure interaction. The objective of the present research is to investigate, by means of apposite experiments and newly developed experimental techniques, and existing high-fidelity CFD/CSD simulation tools for fluid/structure coupling, the challenging fundamental and applied aerodynamic features of helicopters, eVTOLs, and tilt-rotor aircraft, like rotor-rotor and rotor-wing interference effects, blade dynamic stall, blade- vortex interaction, helicopter-obstacle interference effects, rotorcraft drag reduction.
Methods and techniques that will be developed and used to carry out the research	Wind tunnel tests, development of experimental techniques, coupling of CFD and mid-fidelity CFD simulations to multi-body in-house codes for fluid-structure interaction, development of new generation unstructured, adaptive CFD codes for accurate simulation of blade-vortex interaction and vorticity dynamics.
Educational objectives	Deep understanding of the flow physics of rotary wing vehicles, expertise in developing computational tools, and performing experiments, assessment of numerical simulation and experiments results.
Job opportunities	Senior aerodynamicist

POLITECNICO DI MILANO

Composition of the research group	1 Full Professors 3 Associated Professors 0 Assistant Professors 9 PhD Students
Name of the research directors	L. Vigevano, G. Gibertini, A. Guardone, A. Zanotti

Contacts
giuseppe.gibertini@polimi.it, (Tel.) +39-02-2399.8389 alberto.guardone@polimi.it, (Tel.) +39-02-2399.8393 alex.zanotti@polimi.it, (Tel.) +39-02-2399.8066

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: ROTORCRAFT AEROMECHANICS AND DESIGN

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	Rotorcraft aeromechanics encompasses flight dynamics and control, rotor dynamics and aeroelasticity. These disciplines are crucial to modern rotorcraft design and analysis, given the intimate coupling of aerodynamics, structural dynamics, control and aeroelasticity impacting on rotorcraft performance and handling qualities. The objective of the present research is to integrate and augment existing prediction methods of varying levels of fidelity to support the analysis and optimal design of rotorcraft system, including nonconventional configurations. The derivation of design criteria is sought, with special attention to innovative light rotorcraft and new generation tilt-rotors.
Methods and techniques that will be developed and used to carry out the research	Integration of flexible multibody solvers, performance (flight mechanics) prediction tools, blade/rotor structural analysis tools, and other simulation codes within an optimization environment for rotorcraft design. These technology will be used to design, optimize and verify one or more rotorcraft systems.
Educational objectives	Expertise in modern integrated aircraft design methodologies and tools, deep understanding of rotorcraft aeromechanics.
Job opportunities	Senior aircraft designer/flight dynamicist/rotor dynamicist
Composition of the research group	0 Full Professors 2 Associated Professors

	1 Assistant Professors 1 PhD Students
Name of the research directors	Lorenzo Trainelli, Alessandro Croce

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano - Italy +390223998323 - email: phd-daer@polimi.it - web site: www.aero.polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: ROTORCRAFT MULTIDISCIPLINARY DESIGN

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	Modeling the dynamics of rotorcraft requires the tight integration of multiple disciplines. Nonlinear structural dynamics, steady and unsteady aerodynamics, control systems, and the modeling of other subsystems â€“ such as hydraulics, ice formation and shedding, and pilot and passenger biomechanics â€“ are all necessary to investigate these complex dynamical systems.The objective of this research is to develop multidisciplinary virtual simulation systems to support the conception, design, analysis, testing, certification, and operation of rotorcraft and eVTOL vehicles, particularly in the context of advanced air mobility and the transformative potential it brings to this domain.Numerical models and flight simulators are employed to explore issues related to human-machine interaction. Within this research area, several challenges have been â€“ and continue to be â€“ addressed, including aeroservoelastic stability, rotorcraft-pilot coupling, vibration control, ice accretion, and morphing systems.
Methods and techniques that will be developed and used to carry out the research	The development of numerical virtual models will rely on the use of in-house multibody-multidisciplinary codes, complemented by both open-source and in-house CFD solvers. Fixed-base flight simulators, motion-base platforms for pilot biomechanical testing, and various virtual reality-based systems â€“ developed within the FRAME Lab â€“ will be employed to investigate the interaction between these systems and pilots or other operators.

Educational objectives	The educational objectives include developing a deep understanding of the dynamics of fixed- and rotary-wing air vehicles, gaining expertise in the development of computational tools and the execution of experiments, and acquiring the ability to critically assess the results of numerical simulations and experimental data.
Job opportunities	Possible job opportunities include positions in industry, research institutions, and regulatory bodies, with a focus on the modeling, simulation, and testing of rotorcraft and eVTOL systems. Typical roles may include senior flight physics expert, rotorcraft dynamicist, simulation engineer, or systems integration specialist. The multidisciplinary nature of the research also prepares candidates for positions involving advanced air mobility, human-machine interaction, and virtual prototyping.
Composition of the research group	3 Full Professors 0 Associated Professors 1 Assistant Professors 20 PhD Students
Name of the research directors	G. Quaranta, P. Masarati, A. Guardone

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali Politecnico di Milano Via La Masa 34, 20156, Milano giuseppe.quaranta@polimi.it, +39-02-2399-8405 pierangelo.masarati@polimi.it, +39-02-2399-8309 alberto.guardone@polimi.it, +39-02-2399-8393

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: SPACE SURVEILLANCE AND PROXIMITY OPERATIONS

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	In recent years, in orbit population has become a remarkable problem for space agencies and institutions all around the world, and even in cislunar space. Among orbiting objects, just a small fraction is represented by co-operative satellites and the main part is composed by space debris, which include inactive satellites, rocket bodies, and fragments of all sizes. Space debris represent a threat to space activities, as an in-orbit collision could imply catastrophic consequences. Therefore, different strategies have been implemented to guarantee safe operations, and an international commitment is currently taking place in the Space Situational Awareness field, with focus on the Space Surveillance and Tracking (SST) applications both around the Earth and in cislunar space. With the expansion of the in-orbit objects population, the risk of potential service interruption increases due the limited capability of replacing or reconfiguring existing satellites after a failure. This problem has been faced in the past by adopting multiple active satellites to serve the same purpose, thus guaranteeing a hot redundant approach and the consequent mitigation of service interruption risks due to failures or unavailability (i.e. during collision avoidance manoeuvres) of a subset of the satellites. However, as the number of in-orbit objects increase, this approach tends to be unfeasible or inefficient, and two possible actions can be taken: removal of non-active objects (to reduce the population size) and extension of the operational life of active one. On orbit servicing, on orbit assembly and, active debris removal

	missions, impose additional constraints deriving by the need of operating in close proximity to potentially unknown or uncooperative targets. This will pose relevant challenges to the guidance, navigation and control of the platform, especially when the large uncertainties associated to uncooperative objects is considered. The objective of this research is twofold, on one side to improve existing capabilities in Space Situational Awareness/Space Traffic Monitoring, and on the other side to investigate innovative technologies dealing with the problem of close proximity operations.
Methods and techniques that will be developed and used to carry out the research	The research activities are structured in three main research lines: 1) Space Situational Awareness (SSA)/Space Traffic Monitoring: The research aims at improving or developing new methods dealing with space objects cataloguing and Space Surveillance and Tracking services such as Reentry, Fragmentation, Conjunction analysis and Collision avoidance; both ground systems and on orbit (including cislunar) are considered. 2) Military SSA applications: The research aims at improving methods and techniques tailored to the defense of space assets such as maneuver detection, anomaly detection, threat assessment, threat mitigation, satellite protection; 3) Proximity operations: The research aims at developing innovative methodologies and technologies dealing with autonomous relative navigation (including ImageÂ processing and synthetic image generation), autonomous guidance strategies for proximity operations (i.e. inspection, rendezvous) Â and space robotics operations.
Educational objectives	To create specialists in the field of Space Situational Awareness (SSA)/Space Traffic Monitoring and Proximity Operations by means of advanced courses, to improve and broaden the technical knowledge and skills of Ph.D. candidates, and direct participation in world-class research activities. The candidate will gain a profound knowledge about the concepts related to the fields of astrodynamics, estimation techniques, numerical

	methods, mathematical modelling and computer programming. Soft skills in writing reports, searching bibliographic resources, preparing progress meetings and presenting work advancements will also be achieved.
Job opportunities	Activities aiming at guaranteeing a sustainable use of space are nowadays the focus of several companies, national agencies and universities. Deep theoretical and practical knowledge of the topics investigated in this research will ensure a high appeal for the candidate in the space community. The development of innovative technologies aimed at the solution of the in-orbit-servicing and active-debris-removal problems are of great appeal to companies, agencies and university actively developing new applications in the field of close proximity operations.
Composition of the research group	0 Full Professors 2 Associated Professors 6 Assistant Professors 14 PhD Students
Name of the research directors	P. Di Lizia, M.Massari, M.Maestrini, M.F.Montaruli

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali Ã¢â‚¬â€œ Politecnico di Milano Via La Masa 43, 20156, Milano Ã¢â‚¬â€œ Italy pierluigi.dilizia@polimi.it, (tel. +39 02 2399 8370) mauro.massari@polimi.it, (tel. +39 02 2399 8379) michele.maestrini@polimi.it (tel. +39 02 2399 8011) marcofelice.montaruli@polimi.it (tel. +39 02 2399 7150)

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad

Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: STRUCTURAL INTEGRITY OF ADVANCED MATERIALS AND STRUCTURES

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	The application of innovative materials and structural concepts in modern vehicle structures introduces new challenging tasks in the design methodologies. Composites materials with polymeric or ceramic matrices, as well as hybrid and smart structures are difficult to be designed and verified by using classical stress-based analysis. In such cases, the analysis of the structural integrity requires more complete and multi-scale numerical approaches, based on non-linear constitutive laws, which can take into account defects, residual stresses induced by manufacturing process, development of subcritical damages and statistical distribution of properties. The objective of the research is a further development of existing approaches and constitutive laws, at different scale levels, and their effective application in the design process of real-world advanced composite and smart structures.
Methods and techniques that will be developed and used to carry out the research	The research will involve a possible development of new constitutive laws for the thermo-mechanical response of materials, and the application of already developed modeling techniques for the design of structural components, within a multi-scale approach and a strong interaction with experimental activities.
Educational objectives	Acquisition of numerical and testing skill for the management of the design process of advanced structural

	components
Job opportunities	Senior design engineer of composite/smart structures, Senior materials scientist
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 1 PhD Students
Name of the research directors	A. Airoldi

Contacts
alessandro.airoldi@polimi.it (tel. +39-02-2399.8363)

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: TRAJECTORY DESIGN AND CONTROL THROUGH ORBIT MANOEUVRING AND PERTURBATIONS FOR APPLICATION TO SPACE SUSTAINABILITY

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	Space assets offer services of social and economic benefit for the humankind and enable monitoring the condition of our planet. As our lives become more and more interconnected thanks to the development of space economy and space is more easily accessible, Space can be seen as the extension of our planet biosphere. As such, long-term sustainability of space activities must be ensured, by means of propermethods and tools tocharacterise the objects' distribution in the outer space, to forecast the space system capacity over time, and to design specific control actions on the evolution of the space population. From one hand, extensive and sustainable exploitation of space assets requires international coordination and regulation towards the definition of mitigation guidelines and safe operations. On the other hand, the space community is now setting the basis towards circular economy, strongly relying on the opportunities unlocked by complex forms of cooperation and interaction between artificial satellites, such as on-orbit servicing, assembly, and re-cycling to promote the long-term sustainable exploitation of the outer space and maximise technology and economical return of space systems.The COMPASS Lab research activities focus on: •Space sustainability. •Space traffic management. •Planetary protection and defence. •Mission analysis and design.

	•Space services and space economy.
Methods and techniques that will be developed and used to carry out the research	The characterisation of the Earth and cislunar environment and outer space is performed leveraging astrodynamics, orbital mechanics and uncertainty modelling to develop methods and software to model the debris population, perform planetary protection analyses and to devise control approaches of the space capacity allocation for application of Science to Policy. Control theory, mission analysis, trajectory design and optimisation approaches are developed for space debris mitigation (i.e., End-of-life disposal design) and Space Traffic Management (collision avoidance manoeuvres, re-entry predictions, fragmentation reconstruction) are studied and enhanced towards their operational validation in space. To maximise the technology and economical return of space systems, solutions to service operative spacecraft (maintenance/repair a/o life extension services) and to reduce the access-to-space cost by assembling large structures directly in space (recycling space assets) need to be conceived. Here the focus is on advanced algorithms of guidance, navigation, and control applied to distributed space systems. Mission analysis and mission design to support the design of several missions devoted to maturing key technology and know-how for deepen our knowledge of the space environment and to exercise remediation actions will be developed. The COMPASS Lab is also committed to foster the development of advanced space-based services, that either exploit the opportunities unlocked by complex forms of cooperation and interaction between artificial satellites, constellations design for space economy applications, or study advanced socio-economic philosophies and approaches to the space field.
Educational objectives	The objective of PhD in the COMPASS Lab is to develop skills in the dynamical system theory and long-term orbit evolution, astrodynamics, modelling of space debris, space traffic management, guidance navigation and control for distributed systems. Through this PhD project the candidate will develop skills in mathematical

	development, simulations, programming (Phyton, Matlab, C++), high performance computing, software development. Soft skills in presenting the research, writing reports, developing operational code, outreach, dissemination, and preparing industrial progress meetings will be also achieved through the PhD work. The PhD candidate will be also involved in the research, industrial projects, organisational and outreach activities of the group. The educational objectives are to create specialists in the field of mission analysis and space systems optimisation by means of advanced courses, to improve and broaden the technical knowledge and skills of Ph.D. candidates, and direct participation in world-class research activities.For further information on the project visit: www.compass.polimi.it
Job opportunities	Foreseen job activities include (1) research in international, European, and Italian research centres and space agencies in particular the European Space Agency, the Italian Space Agency; (2) industries related to the design and manufacturing of satellites and space components, space operations, and provision of services from space; (3) research in Italian and foreign universities. Post-doctoral grants are available to Ph.D. within the department.Job opportunities after a PhD on this topic can be in any of the space agencies, in particular the European Space Agency, the Italian Space Agency and the several European companies and research institutions involved in space debris mitigation, space traffic management, space situational awareness, space policies and mission design.
Composition of the research group	2 Full Professors 1 Associated Professors 3 Assistant Professors 12 PhD Students
Name of the research directors	Camilla Colombo, Gabriella Gaias, Franco Bernelli

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali Politecnico di Milano Via La Masa 43, 20156, Milano, Italy

Camilla.Colombo@polimi.it, (tel. +39 02 2399 8352)
Gabriella.Gaias@polimi.it, (tel. +39 02 2399 8325)
Franco.Bernelli@polimi.it

www.compass.polimi.it
https://www.aero.polimi.it/it/laboratori-scientifici/compass-control-for-orbit-manoeuvring-through-orbit-perturbation-for-application-to-space-sustainability

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: TURBULENT FLOWS, INSTABILITY AND CONTROL

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	This is a wide research field encompassing instability and turbulence. Turbulent flows are widespread in applications; their numerical simulation (at various cost and accuracy levels, ranging from RANS to DNS) is essential in the design process of virtually any system with a moving fluid. The statistical description of turbulent flows is a field of fundamental research. In flow control, one aims at improving the performance of a fluid system by external manipulation (e.g. actuators) or simply by improved design (shape optimization or surface texturing). Sometimes flow control acts on a developing flow to hinder its instabilities; other times the control strategy aims at modifying the cyclic behaviour of a dynamical system.
Methods and techniques that will be developed and used to carry out the research	When studying instability and turbulence, a number of numerical techniques are employed, ranging from DNS to LES and RANS, together with a broad range of powerful mathematical tools. The group is active in developing and improving numerical tools in DNS (e.g. highly efficient parallel solver) and LES (e.g. new hybrid RANS/LES models; studying the grid and p-adaptivity for a Discontinuous Galerkin Finite element). From the experimental viewpoint, we develop plasma actuators for a number of applications. From the standpoint of control laws, we are leading the research of energy-efficient control laws for turbulent skin-friction drag reduction in wall-bounded flows. Several optimization strategies, including those based on the adjoint operator, are used in

	a number of applied problems, including some of biomedical interest.
Educational objectives	Understanding the physics of a near-wall turbulent flow is a common educational goal. Depending on the specific project, additional objectives may be control theory, or experience in laboratory work, actuator development, high-level computer programming, and high-performance computing.
Job opportunities	CFD engineer, control specialist, experimental aerodynamicist
Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 2 PhD Students
Name of the research directors	Prof. A. Abbà, F. Auteri, M. Belan, M. Quadrio

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano Via La Masa 34, 20156, Milano - Italy +39022399 antonella.abba@polimi.it, (Tel.) +39-02-2399.8354 franco.auteri@polimi.it, (Tel.) +39-02-2399.8046 marco.belan@polimi.it, (Tel.) +39-02-2399.8045 maurizio.quadrio@polimi.it, (Tel.) +39-02-2399.8349

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 41st cycle

OPEN SUBJECT Research Field: WIND ENERGY SYSTEMS

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	Systems for generating electricity from renewable sources, and in particular from wind, are continuously expanding to meet the ever-increasing demand for green electrification.Â Conventional on-shore and off-shore wind turbines havereached dimensions and complexity that, together, create ongoing challenges. But even small wind turbines, with horizontal or vertical axis, have different complexities due to their particular applications and lower costs. Last, but not least, new technologies, such as high-altitude power generation, Airborne Wind Energy Systems, are joining the previous ones to complete the energy mix and pose new technological challenges (aerodynamics, flight-mechanics, aeroelasticity, control, regulations, etc.).Â These complex systems have their own characteristics but also others in common, including the need to integrate several advanced engineering technologies(aerodynamics, structure, material, aeroelasticity. control, etc.) into a single effective multidisciplinary complex system.Â For this reason, the goal of this research is to develop technologies for the multidisciplinary design, analysis, and optimization (MDAO) of such complex systems.
Methods and techniques that will be developed and used to carry out the research	The research is carried out through a mix of numerical and experimental activities.The development of tools for MDAO may be done in synergy with any project-funded experimental tests that are quite regularly found within the research group.The numerical tools are mainly developed within theresearch group (such as aero-servo-hydro-

	elastic code,wind turbine design tool, engineering models, etc.) oropen-source tools may be used and updated.
Educational objectives	The main educational objective is to develop skills for the analysis and system integration of technologically advanced complex systems, such as floating offshore wind turbines, small land-based wind turbines, and airborne wind energy systems.Moreover, one learns to identify the appropriate mathematical model for the type of task and to integrate this model into a much more complex multidisciplinary system. The PhD candidate will then have the opportunity to conduct classroom lectures and supervise and monitor the work of thesis studentsFinally, one learns to work in a team, getting involved in activities with other researchers in the group.
Job opportunities	This research activity opens up the industrial world where highly complex systems integration skills are required.Therefore, not only in the wind energy sector (wind turbine manufacturers and/or wind farm operators) but also in related industries, such as aerospace, automotive, racing boats, etc.
Composition of the research group	1 Full Professors 2 Associated Professors 0 Assistant Professors 5 PhD Students
Name of the research directors	Alessandro Croce

Contacts
Prof. Alessandro Croce Dipartimento di Scienze e Tecnologie Aerospaziali Politecnico di Milano Via La Masa 43, 20156, Milano alessandro.croce@polimi.it https://www.aero.polimi.it/en/staff/alessandro.croce

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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.