



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

PNRR 630 Research Field: SIMULATION OF NON-LINEAR STRUCTURAL LOADS WITH THE INTEGRATED APPROACH OF HYBRID SIMULATIONS

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

One of the main challenges in aircraft design is that of determining the structural loads from manoeuvring and gusts by addressing structural dynamics problems with an integrated approach. Indeed, to satisfy the new stringent requirements in terms of environmental impacts, future aircraft will be characterized by more efficient and more flexible structures, unconventional configurations such as very high aspect ratio, maybe distributed propulsion, combined with innovative technologies such as massive adoption of active controls. This kind of structure will be prone to many and different aeroelastic phenomena, as well as, due to the typical low structural frequencies, the interaction between flight mechanics and aeroelasticity becomes evident. The ability to evaluate the interactions and effects on the structural loads of modern flight characteristics control systems and active load alleviation systems during the dynamic response of the structure to the manoeuvring, buffeting or gust phases, is therefore fundamental and a higher fidelity aerodynamic should be impended in the loop to improve the loads' evaluation. This project aims to implement a multidisciplinary simulator (flight mechanics, structural dynamics, aerodynamic models and flight-load alleviation control system) for structural loads on flexible aircraft, implemented in a Matlab environment. The implementation aims to carry out multidisciplinary simulations, in the time domain, directly connecting the control systems with the equations of motion combined



	with a flexible aircraft model and improved aerodynamics by means of CFD data.
Methods and techniques that will be developed and used to carry out the research	The research activity carried out under the AeroStructures Design Laboratory (ASDL) specialized in the development of multi-fidelity analysis and design methods to enable fast and efficient generation of aero-servo-elastic models. The candidate will need to manage, use and develop in an autonomous way a suitable methodology that aims to carry out multidisciplinary simulations, in the time domain, directly connecting the control systems with the equations of motion combined with a flexible aircraft model and improved aerodynamic by means of CFD data and delivery the relevant simulation tool. The underlying model structure consists of the nonlinear equations of motion of a free-flying, flexible aircraft, as well as a model, which calculates the distributed aerodynamics over the entire airframe. Different possibilities in modelling the unsteady aerodynamic interactions for design loads purposes shall be explored and the effects on the loads shall be compared in order to assess the tradeoffs between accuracy and speed.
Educational objectives	Enhance a multidisciplinary approach to aircraft design; improve the capability to manage the entire set of aircraft requirements; acquire familiarity with the numerical tools typical of conceptual and aircraft design phases relevant to the definition of the design structural loads (static and dynamic), including the novel aspects related to active control technologies; open mind to approach aircraft design problems via a blended mix of numerical multi fidelity tools.
Job opportunities	The acquired scientific skills cover a wide range of engineering applications and are strongly requested by high technology industries, nonlimited to the aerospace field.
Composition of the research group	1 Full Professors 1 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	Prof. Sergio Ricci



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 Aircraft
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	To be defined
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.