



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 39th cycle

THEMATIC Research Field: BOUNDARY LAYER CONTROL BY ELECTROACTIVE ACTUATORS

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	<p>Friction drag contributes half of the total drag of a commercial aircraft, therefore its reduction provides a unique opportunity to save fuel and significantly decrease the CO₂ and pollutant emissions of air transportation. According to a recent estimate, a potential 15% drag reduction could be obtained from transition, turbulence, and separation control.</p> <p>This project aims to apply novel control techniques, in terms of actuation and control strategies, to delay transition, reduce turbulent drag, and prevent separation in boundary layers over airfoils. The control techniques will be formulated theoretically, tested numerically by high-fidelity techniques, and then assessed experimentally through wind tunnel tests.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The research project will be carried out by a mixed theoretical-numerical approach, using purposely developed solvers for the incompressible Navier-Stokes equations. Optimal control theory and the Wiener-Hopf approach will be leveraged to define and solve the control problem. An experimental part is also foreseen where the developed control strategies will be applied to small prototypes first and, eventually, to a wing section at nearly full scale.</p>
Educational objectives	<p>The project aims to train a Ph.D. candidate in the field of aerodynamics, with a particular focus on the stability and</p>



	control of laminar and transitional boundary layers and the control of turbulent boundary layers. The Ph.D. candidate will also have the opportunity to use highly parallel numerical techniques, a deep understanding of such methods is an educational objective. Moreover, the experimental activity will allow the candidate to mature an operative understanding of advanced measurement techniques, such as hot wire anemometry, particle image velocimetry, and infrared thermography.
Job opportunities	Job opportunities in the academic sector and in R&D offices in the industry can be foreseen as the outcome of the Ph.D. programme. This is the result of the advanced techniques, theoretical, numerical, and experimental that the Ph.D. candidate will learn and use. The job opportunities could be concerned with both the numerical and the experimental acquired competencies.
Composition of the research group	0 Full Professors 1 Associated Professors 0 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Franco Auteri

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

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.