



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 40th cycle

THEMATIC Research Field: NOVEL FUEL-FLEXIBLE GAS TURBINES FOR CLEAN MARITIME 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

The research aims at developing novel fuel-flexible gas turbines for clean ship propulsion, considering multiple fuels including hydrogen, ammonia, and carbon neutral compounds. The research is focused on the turbomachinery design, with particular emphasis on the turbo-expanders but also considering the turbo-compressors operating in the system. In the initial phase, a preliminary design of the turbomachinery will be carried out applying mean-line design tools, as well as a conceptual design of the turbine cooling system, considering the peculiar features of the engine. Subsequently, higher fidelity models based on Computational Fluid Dynamics will be applied to optimize the machines, and a novel shape-optimization strategy, tailored to consider fuel flexibility, will be conceived, developed, and applied. The turbomachinery designed will be subsequently analysed for a large set of fuels in design and off-design conditions, to fully characterize their performance and nominal and part-load, to support the construction of a digital twin of the propulsion system.

Methods and techniques that will be developed and used to carry out the research

The doctoral candidate will apply multi-fidelity computational tools for the design and analysis of axial and radial turbomachinery, introducing the necessary updates and specific features required to deal with gas turbines operating with novel fuels, and even fuel



	blends. The doctoral candidate will also have to develop a novel shape-optimization technique for turbomachinery which is able to take into account the variability of the fuel and its implication on the turbine aerodynamics and heat transfer. The doctoral candidate will have to deal with the blade cooling system, considering in particular the impact of the diverse fuels on the heat transfer between the blades and the main flow expanding into the turbine, and its implication on the blade cooling system.
Educational objectives	The ultimate educational objective is to provide a high-level knowledge about advanced thermo-fluid-dynamic concepts applied to thermal fluid machine design and optimization. This will come with up-to-date skills for Fluid-Mechanics and Thermodynamic modelling.
Job opportunities	National and international Companies in the field of propulsion and energy conversion systems, with specific focus on turbomachinery design and operation. Consultancy companies. Private and public research centres.
Composition of the research group	3 Full Professors 1 Associated Professors 2 Assistant Professors 6 PhD Students
Name of the research directors	Giacomo Bruno Azzurro Persico

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



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

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.

Desk availability: individual use.