



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 38th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

PNRR_352 Research Field: FLOATING WIND FARM CONTROL

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

Wind energy is a clean available renewable energy source, in 2019 wind energy saved 118 million tonnes of CO₂ in Europe and could save up to 270 million tonnes in 2030 - the equivalent of Spain's annual CO₂ emissions, moreover wind does not need to be mined or shipped and the more we use, the closer Europe gets to real energy independence and operating wind turbines do not emit greenhouse gases like carbon dioxide, considering both onshore and offshore, wind energy represents one of the cheapest renewable source on the market. It is estimated that 60-80% of the offshore wind resource of Europe is located in waters deeper than 50 m. Offshore wind turbines have been routinely installed on bottom- fixed foundations (i.e. the wind turbine is connected to the seabed), but this is no longer feasible in waters deeper than 50 m. The main limitation to the bottom-fixed technology is the increased hydrodynamic loads experienced by the support structure members that must be of larger diameters. The floating concepts can be generally implemented in areas where water depths are higher than 50-70 meters. These water depths are considered as a technical and economical limit for the conventional fixed bottom foundation types. Floating wind foundations are however a frontier technology since there are not yet operative large-scale commercial farms anywhere in the world nowadays. Their maturity though is



	<p>growing rapidly, with several concepts on various stages of development, with most of them at prototype level. A small number of floating concepts has already reached the pre-commercial demonstration level. Moving from the single turbine to the wind farm represents another big challenge of the research, in particular new and dedicated control strategies -at farm level- could represent a quantum leap in extracting power from the flow, reducing the costs of energy and making it more competitive on the market.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Research objectives will be pursued combining numerical modelling and experimental tests and the state of the art of floating wind turbine control engineering. Reduced order models, multibody simulations and multi-fidelity models will be used for the design process. Considering the interdisciplinarity of the topic; the very complex aerodynamics and hydrodynamics problems the research must be studied with proper numerical and experimental methods.</p>
<p>Educational objectives</p>	<p>We provide doctoral candidates with high-level scientific training, fostering and refining research and problem-solving abilities by focusing on both theoretical and experimental skills. A PhD in Mechanical Engineering will be able to layout, draft and carry-on original research, by leading a research group or working in a team.</p>
<p>Job opportunities</p>	<p>Job opportunities can be found in the wind energy industry, floating wind energy industries, renewable energy. Among the companies and institutions that are cooperating in the research ENI, TUDelft and Peak Wind can be listed.</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the same field.</p>
<p>Composition of the research group</p>	<p>3 Full Professors 4 Associated Professors 4 Assistant Professors 5 PhD Students</p>



Name of the research directors	Prof. Marco Belloli
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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)	ENI S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Delft University of Technology
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5.707, 13.
Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. 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