MECHANICAL ENGINEERING

MUR DM 118 - Offshore renewable energy underwater noise evaluation and mitigation strategies, in collaboration with Pantelleria Municipality.

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019]
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Context of the research activity	Offshore wind turbines and wave energy converters on floating foundations allow to exploit large areas of the sea far away from the coast, characterized by higher wind and wave resource. In these applications, underwater acustics emissions are nowadays not completely studied and understood, being the marine energy field in recent development. Design and control of such system must take into account also underwater noise, to be able to increase installability and environmental compatibility.
	The proliferation of marine renewable energy devices, such as offshore wind turbines and wave energy converters, has raised significant concerns regarding their potential impact on the marine environment. This PhD research aims to investigate the engineering aspects related to assessing and mitigating the noise generated by these devices. By optimizing their design, materials, and control algorithms, the goal is to minimize noise levels and mitigate their adverse impact on the marine ecosystem and fauna. While studies have comprehensively addressed noise emissions from activities like shipping and offshore oil extraction, research specifically focused on noise generated by marine renewable energy devices remains limited. This study seeks to bridge this knowledge gap by exploring the dynamics of noise propagation from these devices and evaluating its ecological consequences. The research methodology will involve integrating mathematical modelling, experimental measurements, and optimization techniques. In addition to software for mechanical modelling and control of such devices, mathematical models, such as RAM (Ray Acoustic Model), ENS3D (Environmental Noise Source 3D), and ParAcousti, will be used to simulate and predict noise propagation, considering factors such as water depth, seabed

Objectives	characteristics, and underwater structures. These software tools utilize advanced calculation methods and numerical modelling approaches to accurately simulate sound propagation in complex marine environments. In addition to evaluating noise propagation, the research will focus on optimizing the design, materials, and control algorithms of marine renewable energy devices to reduce noise emissions. Strategies may include aerodynamic or hydrodynamic enhancements, the integration of acoustic damping materials, and the incorporation of noise-reducing components. Computational fluid dynamics simulations and structural analyses will be used to assess the impact of these strategies on noise generation and propagation. Furthermore, the research will explore the development and application of advanced control algorithms to actively manage and regulate noise emissions from these devices. By optimizing control strategies, it will be possible to minimize noise production while maximizing energy output. In summary, this PhD research aims to advance the understanding of noise propagation from marine renewable energy devices and devise effective strategies for noise mitigation. By optimizing design, materials, and control algorithms, the objective is to minimize the adverse impact on the marine ecosystem and its fauna. The study employs a holistic approach that integrates mathematical modelling, experimental measurements, and optimization techniques to deepen our understanding of noise impact and develop sustainable solutions for marine renewable energy systems that preserve the delicate balance of the marine ecosystem and its fauna.

Skills and competencies for the development of the activity	The following abilities are preferable in the Candidate, and they will be enhanced during PhD: - Ability to carry out analysis and synthesis on the state of the art of technologies and methods - Ability to present a scientific work both in oral and written form - Proactivity, independent and parallel thinking - Familiarity with the Matlab & Simulink environment, and 3D modeling CAD software (preferably Solidworks)