

Editorial Note

This is the first issue of the Newsletter of the Mechanical Engineering Department (DEM) of Instituto Superior Técnico (IST) of the University of Lisbon. It is not intended to be restricted to academic faculty, researchers and staff of DEM but rather aims at a broad dissemination of relevant news and activities of DEM. The target audience includes everybody working in areas that overlap to some extent to those developed at DEM/IST. The Newsletter is also posted in the [webpage](#) of DEM.



Industry Day

The Newsletter has a periodicity of 6 months, focusing on the report of a few flagship projects in progress or recently concluded that are relevant to the society or stakeholders. These projects are carried out in the framework of the following research centres, where most of the academic faculty of DEM are affiliated: the Centre for Innovation, Technology and Policy Research (IN+), the Centre for Marine Technology and Ocean Engineering (CENTEC), the Institute of Mechanical Engineering (IDMEC) and the Marine, Environment and Technology Centre (MARETEC). All these research centres were rated as excellent in the last evaluation of the Portuguese research units undertaken by the Portuguese Foundation for Science and Technology (FCT).

IN+ is dedicated to the integration of scientific research in technology, innovation and public policies, with the final goal of promoting sustainable applications for science, industry and society. It focuses on Industrial Ecology and Sustainability, Thermofluids, Technology Management and Policy Research. CENTEC is concerned with the various areas of Naval Architecture and Ocean Engineering, such as maritime transport and ports, ocean space utilization, including coastal areas, exploration and exploitation of marine resources, and nautical activities, as well as the protection of the marine environment and its resources. IDMEC develops fundamental and applied research in five areas: aerospace science and technology; energy and fluid mechanics; intelligent systems; manufacturing and industrial management; and mechanical design. MARETEC is a research centre for marine, environment and technology with two main research areas: modelling of marine and land systems, and sustainability. In this first Newsletter, one project from each research centre is addressed.

DEM President: Pedro Coelho

Editorial Board: Pedro Coelho (DEM President), Filipa Moleiro (DEM Dissemination), Tiago Santos (CENTEC), Duarte Valério (IDMEC), Patrícia Baptista (IN+), Marcos Mateus (MARETEC).

Student Admissions

The number of students who enrolled in the bachelor's programmes under the responsibility or co-responsibility of DEM in the academic year 2023/2024, along with the minimum admission grade, are as follows:

- Aerospace Engineering – 135 students, minimum admission grade 186.8
- Environmental Engineering – 31 students, minimum admission grade 135.5
- Materials Engineering – 25 students, minimum admission grade 146.3
- Mechanical Engineering – 160 students, minimum admission grade 173.0
- Naval Architecture and Ocean Engineering – 30 students, minimum admission grade 158.3

New Academic Faculty

International documental recruitment competitions recently held for tenure track Assistant Professor positions in DEM/IST led to the following new Assistant Professors, to whom DEM wishes a bright academic and research career:

- Alain Souza – Scientific Area of Applied Mechanics and Aerospace Engineering
- Carlos Quental – Scientific Area of Structural and Computational Mechanics
- Joana Portugal Pereira – Scientific Area of Environment and Energy
- João Pragana – Scientific Area of Manufacturing and Industrial Management

Retired Academic Faculty

The following Professors recently retired, to whom DEM is grateful for their dedication and wishes all the best in the new stage of their lives:

- Aires dos Santos – Scientific Area of Environment and Energy
- Eduardo Matos Almas – Scientific Area of Mechanical Design and Engineering Materials
- Emília Rosa – Scientific Area of Mechanical Design and Engineering Materials
- Viriato Semião – Scientific Area of Thermofluids and Energy Conversion Technologies

Habilitation

Beatriz Silva and Paulo Peças, Associate Professors of the Scientific Area of Manufacturing and Industrial Management, obtained their Habilitation (Portuguese: *Agregação*) in Mechanical Engineering in November 2023.

Awards

The Ph.D. student Rui Sampaio received the Japanese Society for Technology of Plasticity (JSTP) Award for Young Researchers during the 14th International Conference on the Technology of Plasticity (ICTP 2023), which was held in Cannes, France, in September 2023. This triennial conference is known as the Olympic Games of the technology of plasticity. The preliminary list of 17 candidates selected for this award included two Portuguese candidates, both researchers in IDMEC.

Several Professors of DEM received an award or an honourable mention in the Universidade de Lisboa/Caixa Geral de Depósitos Scientific Awards, as follows:

Awards

- Ângelo Teixeira – Area of Mechanical, Naval and Aerospace (Aircraft Mechanics)
- Patrícia Baptista – Area of Environment and Energy

Honourable Mention

- Ana Moita – Area of Thermofluids and Energy Conversion Technologies
- João Costa Sousa – Area of Computer Sciences and Engineering
- Nuno Silvestre – Area of Mechanical, Naval and Aerospace (Aircraft Mechanics)

Ranking of Scientists

Twelve researchers of IDMEC, four of CENTEC and one of IN+ are among the most-cited scientists worldwide in 2022, according to the most recent release of the Top 2% most influential scientists ranking published by the Stanford University and Elsevier, which includes 200,000 researchers. Moreover, in the career-long impact list, there are fifteen researchers of IDMEC, four of CENTEC and one of IN+.

Ranking of Universities

Several academic subjects addressed by DEM are ranked in the most recent releases (year 2023) of several World University Rankings. Some subjects are only addressed by DEM while others are also covered by other departments or faculties of the University of Lisbon. The University of Lisbon is ranked as follows, including a remarkable 4th place in the world of the area of marine/ocean engineering:

- Energy Science and Engineering
NTU Ranking – 140
- Environmental Science and Engineering
NTU Ranking – 199
Shanghai Ranking – 201-300
- Materials Science
NTU Ranking – 273
- Materials Science and Engineering
Shanghai Ranking – 401-500
- Marine/Ocean Engineering
Shanghai Ranking – 4
- Mechanical Engineering
NTU Ranking – 98
QS World University Rankings – 137
Shanghai Ranking – 151-200



Industry Day

Industry Day

The second edition of the Industry Day organized by DEM was held on October 31, 2023. This event aims to promote the university-industry link and boost future cooperation with the business community. Several topics were covered during the morning, namely university-industry collaboration mechanisms and pitches presented by companies along with proposed research challenges. The event included a round table with DEM professors and students, discussing the challenges of 'Industry 5.0'. Several vehicles and projects developed by the student's organisations working closely with DEM (i.e., AeroTéc, FST Lisboa, PSEM, TFC, TLMoto and TSB), as well as dissertation and thesis posters were on display in the Great Hall of IST. The event included a pitch session, where M.Sc. and Ph.D. students presented their work, and the best presentations received awards. The initiative was sponsored by Produtech R3, a project funded by the European Union under the NextGeneration EU programme.

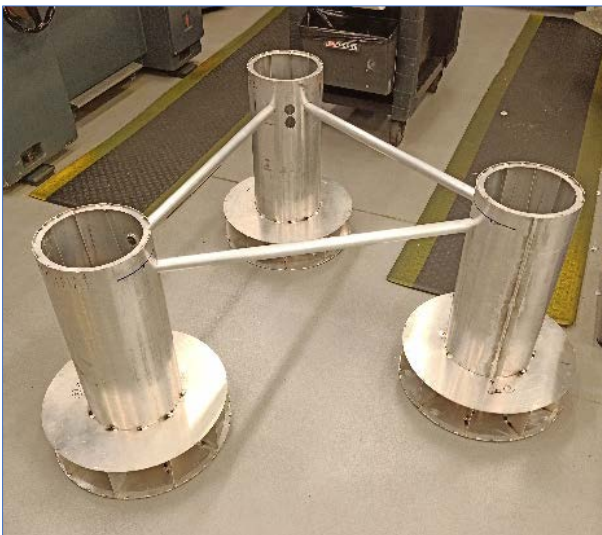
Adaptation of a wave energy converter on an offshore wind platform



The ongoing project aims to develop and adapt a wave energy converter on an offshore platform dedicated to supporting wind turbines. The energy captured from the waves is used to control the movements of the platform, and thus allow the safe operation of the wind turbine, which will be installed at the top of the platform's central column. The aim is to create conditions for the scaling of turbines with greater power and, consequently, a significant reduction in the price of electrical energy, essential for the commercial success of offshore renewables.

The converter consists of three buoys connected to the platform core through articulated arms, which at their ends are connected to an oil-hydraulic power take-off (PTO) device, which converts mechanical energy into electricity and controls the motions of the buoys and the platform. The experimental model is under construction in the workshops of DEM (NOF), under the supervision of a team of researchers and engineers of the Centre for Marine Technology and Ocean Engineering (CENTEC), a research unit of the Department of Mechanical Engineering of IST.

PI: José Ferreira Gaspar



PAC - Portugal AutoCluster for the Future



[PAC](#)'s activities enabled the development, testing and demonstration of a new generation of technologies crucial to the positioning of the national automotive cluster in a new vehicle value chain, addressing the goals of autonomous and connected mobility, resulting in the production of a prototype electric micro-car for use in urban context. The main activities explored concepts associated to vehicle architectures, interiors, structures and exteriors of the future, sensing and connectivity technologies, and flexible and digital production technologies.

IN+ was highly involved in the definition of the vehicle's powertrain architecture, in the development and testing of new materials for the vehicle's seats and main console and in quantifying the full life cycle environmental impacts of the micro-car. The environmental impact of the prototype electric micro-car amounts to 62 g CO_{2eq} per kilometre, which represents a 46% reduction compared to the conventional vehicle technology. Further potential for reduction was identified: up to 16% by transitioning to alternative materials, 44% by incorporating more renewable energy sources into electricity production, and an additional 6% by promoting effective battery end-of-life strategies.

PI: António Luís Moreira



Development of a Greenhouse Gas (GHG) Emissions Calculator for projects

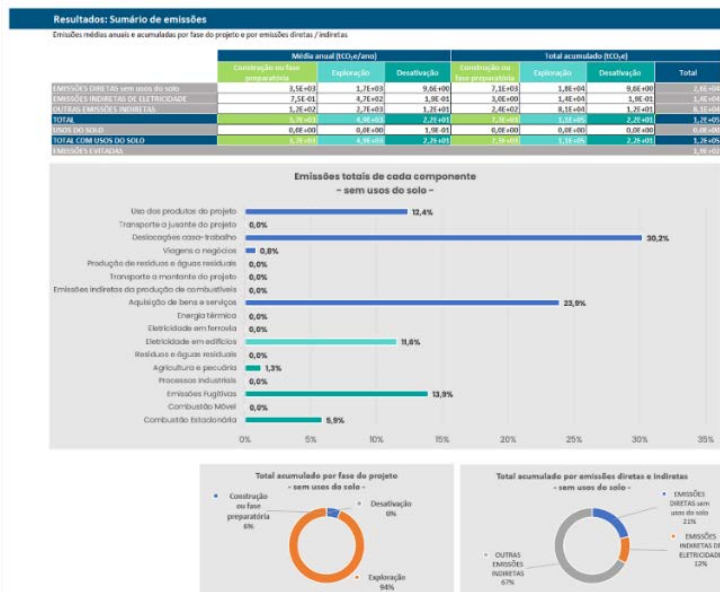


The primary objective of this project is the conceptualization and creation of a Greenhouse Gas (GHG) Emissions Calculator - GEE. The GEE tool is designed to estimate both direct and indirect GHG emissions intricately linked to various project phases, including construction, operation, and decommissioning. A comprehensive approach is adopted, encompassing the emissions directly associated with project activities, while considering indirect emissions stemming from the procurement of energy, goods, and services.

This innovative calculator follows internationally recognized standards and complies with the guidelines set forth by the Intergovernmental Panel on Climate Change (IPCC) and the GHG Protocol. In alignment with the national context, the GEE incorporates country-specific emission factors to ensure accuracy in its estimations.

An integral aspect of this initiative is the commitment of the Secretaria-Geral do Ambiente to fostering transparency and accessibility. Upon completion, the GEE is destined for public release, allowing to leverage its capabilities for informed decision-making.

PI: Ricardo Vieira



M4WIND – Monitoring, Modelling and Machine learning for Managing the operating life of WIND farms



In the context of fatigue analyses, an important source of uncertainties in the design phase of modern Wind Turbines (with large rotors that might be supported by floating platforms) and in the evaluation of consumed fatigue life of older models comes from the difficulty of estimating the realistic stress time histories in the critical sections, since these are influenced by complex load scenarios, by the control algorithms of the turbines and by their aerodynamic, (hydrodynamic) and structural behaviour. Thus, the major goals of the project are the accurate characterization of past, present and future fatigue stresses (or fatigue consumption indexes) on tower and blade sections and the development of tools to enable a smart management of the operating life of these critical structural components.

The foremost novelty of this application is the combined use of 3 Major tools: Monitoring, Modelling, and Machine Learning. These 3Ms will allow estimating the consumed fatigue life of full wind farms with minimal instrumentation, accurately quantify the impact of key factors on fatigue loads and open the path for the fourth M, the Management of the operating life. The ambition of the project is to influence the future rate of fatigue consumption of the turbines of a wind farm using control.

PI: R. B. Santos Pereira

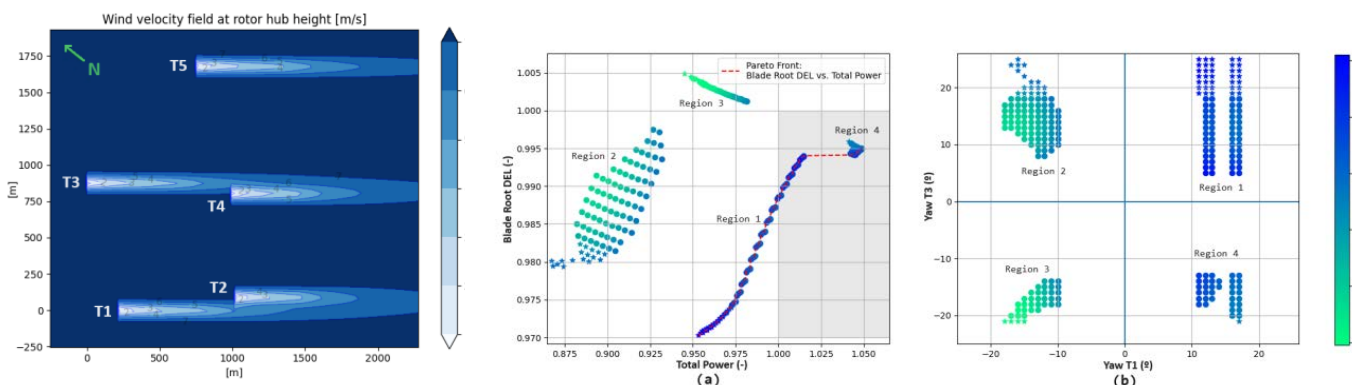


Figure 1: Flow field and wind farm.