International Centre for NUMERICAL METHODS IN ENGINEERING

ANNUAL REPORT 2025

CIMNE

COMPUTATIONAL ENGINEERING RESEARCH
FOR A SUSTAINABLE WORLD

Annual Report 2025

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FOR A SUSTAINABLE WORLD

Table of Contents

1. We are CIMNE	**6**
2. Research	**14**
3. CIMNE in Numbers	**24**
4. Research Impact	**28**
5. UNESCO Chair in Numerical Methods in Engineering	**32**
6. Corporate news	**33**
7. Research and Tech Transfer News	**42**
8. Publications	**55**
9. PhD Theses	**56**
10. CIMNE Labs	**58**
11. CIMNE Congress Bureau	**59**
12. Management of Scientific Associations	**60**
13. Awards	**62**
14. Dissemination	**64**

We are CIMNE

The International Centre for Numerical Methods in Engineering is an R&D&I centre created in 1987 focused on research, technology transfer, and dissemination of computational engineering and numerical methods in engineering.

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CIMNE was established 39 years ago through a collaboration between the Technical University of Catalonia (UPC), the Government of Catalonia and UNESCO. Based in Barcelona and a member of the CERCA network of Catalan research centres, CIMNE has become a **world-leading research institution** specialising in computational mechanics and engineering. Over the decades, it has advanced the fields of civil, mechanical, environmental, biomedical and interdisciplinary engineering, as well as computational physics.

Employing a large international team of multidisciplinary researchers, CIMNE fosters academic exchange through a **network of university-linked CIMNE Labs** (*Aulas CIMNE*) in Spain and Latin America. It has taken part in thousands of research and innovation projects in partnership with global institutions, yielding direct, tangible solutions to pressing societal problems.

The centre hosts the **UNESCO Chair in Numerical Methods in Engineering**, a singular initiative dedicated to advancing technical knowledge for the public good.

In line with its commitment to training and innovation, CIMNE offers a range of Master's programmes, seminars, workshops and doctoral training opportunities. Several highly specialised journals and dozens of technical books have been published under the CIMNE banner, while its **Congress Bureau** specialises in organising highly technical events that bridge the gap between academia and industry.

A Consortium of:

Generalitat de Catalunya

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

In collaboration with:

unesco Chair

CERCA Centres de Recerca de Catalunya

DIRECTOR'S LETTER

Javier Bonet // General Director of CIMNE

Advancing Excellence, Deepening Impact

The International Centre for Numerical Methods in Engineering (CIMNE) was created in April 1987. In May 2025, the Catalan Government and CIMNE signed a four-year core funding agreement. This Contract establishes the framework governing the relationship between the Government of Catalonia—through the Department of Territory, Housing and Ecological Transition and the Department of Research and Universities—and CIMNE for the period 2025-2028. Its overarching objective is to strengthen CIMNE's international leadership as a global reference centre in computational modelling technologies applied to engineering challenges aligned with societal needs and the United Nations Sustainable Development Goals. The contract is fully aligned with CIMNE's Strategic Plan and serves as a core instrument for strategic planning, institutional development, scientific and technological quality improvement, international competitiveness, efficient resource management, and reinforcement of technology transfer and innovation.

The defined strategic pillars identified in the agreement and CIMNE´s strategic plan are:

- Developing a world-leading scientific research programme in computational modelling technologies.
- Attracting and developing top international research talent.
- Securing and efficiently managing financial resources to ensure sustainability.
- Strengthening institutional relationships and enhancing national and international visibility.
- Generate measurable social impact and facilitate technology transfer to industry and society.

1- Developing a research strategy and structure fit for the next phase of CIMNE.

CIMNE has continued to focus its research along 5 key themes and 4 enabling technologies. The key application themes respond to UN Sustainable Development Goals and government priorities at EU, Spanish and Catalan levels. These are:

- Adaptation to Climate Change
- Mobility, Cities and Territory
- Energy and Environment
- Industrial processes
- Health

The key enabling methodologies are:

- Discretisation techniques
- Physical and mathematical models
- Data-driven technologies
- High-performance computational models

Based on these themes and methodologies, CIMNE has consolidated its structure in 9 Research Clusters and 3 Innovation Units. The Research Clusters are responsible for leading the development of research at the highest levels of international excellence, whereas the Innovation Units are focused on applied research and its application to create excellence through impact in society. The work of the Centre is now being reported according to this revised research structure.

Five of the Research Clusters are closely aligned with the application themes and are:

- **Geomechanics & Hydrogeology:** aligned to themes of territory, mobility and adaptation to climate change.
- **Machine Learning and Models in Hydro-Envi-**

ronmental Engineering: aligned to themes of environment and adaptation to climate change
• **Aeronautical, Marine, Automotive and Energy Engineering:** aligned to themes of mobility
• **Solid and Fluid Simulation for Industrial Processes:** aligned to the application theme of industrial processes
• **Computational Mechanics in Medical Engineering and Living Matter:** closely aligned to the theme of health

The four Research clusters are aligned with enabling methodologies and are:
• **Mechanics of Advanced Materials and Metamaterials:** aligned to physical and mathematical models
• **Credible High-Fidelity and Data-Driven Models:** aligned to data-driven technologies
• Structural and Particle Mechanics: aligned to discretisation techniques
• **Large Scale Multiphysics Computations:** aligned to discretisation techniques and high-performance computing

The three Innovation Units are:
• **CENIT:** Innovation Unit in Transport; strongly aligned to the themes of mobility, cities and territory.
• **BEEGroup:** Building, Energy and Environment Group; closely aligned to the themes energy & environment and adaptation to climate change.
• **DIGIT:** Digital services for research and engineering. This unit provides support and development of key industrial software such as GiD and other digital technologies.

Each cluster or unit includes a number of academic leaders who are the Principal Investigators (PIs) responsible for defining its lines of research, identifying specific projects and securing financial resources.

The Scientific Advisory Council visit took place in October, and in addition to meeting with the senior leadership of the Centre, the Council had in-depth discussions with 2 clusters and 2 innovation units. This visit completed the first cycle of the SAC meeting with each of the Centre´s clusters and units. A summary report from the Scientific Council was presented to the governing bodies of CIMNE.

2- Enhancing relationships with our patrons and international partners.
Relationships with the Catalan Government have been considerably strengthened following the signature of the four-year funding agreement. This contract includes specific commitments to enhance the collaboration with sections of the Department, including embedding CIMNE staff within the offices of the Government departments. The overall government support to CIMNE still represents less than 25% of its total funding, but it provides a much-valued contribution to ensuring the financial stability of the Centre.

CIMNE has continued to work closely with the Technical University of Catalonia (UPC), given that a significant number of our principal investigators and academic leaders are also professors at the university. The agreement that governs this relationship has now been renewed twice for one-year extensions, and a fully four-year revised agreement is now being discussed, ready for signature in 2026.

3- Attracting, retaining and developing the best international researchers, innovators and professional support staff.
Prof. Michael Ortiz, a leading figure in the area of computational mechanics, started his tenure as UNESCO Chair in Numerical Methods in Engineering in 2025. On 28 October, Professor Ortiz gave a seminar entitled “Science Meets Data: Scientific Computing in the Age of Artificial Intelligence” at the Palau Robert in Barcelona, to mark his appointment. Prof Ortiz is opening new fields such as the use of quantum computers for numerical methods in engineering and data-enhanced computational mechanics. He visited the Centre for two periods of three months during 2025 and will repeat these visits in future years. During his time at CIMNE, he was able to start numerous collaborations and submit a number of joint proposals for research projects. His incorporation at CIMNE is placing the centre at the forefront of these exciting technological advances.

CIMNE has opened a round of recruitment for young researchers at both pre- and post-doctoral levels. In particular, 10 PhD positions were offered and 6 post-doctoral appointments in different areas. More than 300 candidates from worldwide locations applied to these positions. After an extensive selection process, 16 candidates were appointed and have joined us recently.

Researchers at CIMNE have continued to distinguish themselves nationally and internationally. For instance, the founding director, Professor Eugenio Oñate, was appointed to the Royal Academy of Engineering in Madrid. Professor Michele Chiumenti and Professor Marino Arroyo have been awarded grants in the 2025 Academia Excellence programme, formerly known as ICREA Academia, by the Government of Catalonia.

4- Ensuring that our research has maximum impact in society.
During 2025, the Impact, Innovation and Technology Transfer unit has developed a number of specific impact case studies for submission to iCERCA. In particular, two success stories were presented: namely, the collaboration with ANAV in the safety certification of nuclear containment buildings through advanced numerical modelling, and the spin-off Build-Air, which enabled the deployment of inflatable membrane structures through numerical simulation. These were assessed by international experts and were awarded scores of B+ and A-, respectively.

During 2025, the Catalan Minister of Research and Universities Honourable Ms. Núria Montserrat Pulido, the Minister for Business and Labour Honourable Mr. Miquel Sàmper i Rodríguez, and the Minister for Territory Honourable Ms. Sílvia Paneque i Sureda visited the Centre to learn about the ways in which we develop research and transfer it to society.

RESEARCH FOCUS, OUTCOMES and ACHIEVEMENTS

During 2025, research at CIMNE has focused on the development of NM of interest to the following scientific fields: structural mechanics, geomechanics, fluid dynamics, material sciences, optimisation, biomechanics, coupled multi-physics processes and high-performance computing. Applications include problems in civil, mechanical, aeronautics, naval/marine, biomedical and environmental engineering, energy efficiency and fusion technology, among others.

A description of the different activities carried out at CIMNE can be seen at the new CIMNE web pages, which were launched in 2025

In 2025, CIMNE researchers published 193 papers in JCR journals, around 70% of them in first-quartile journals, while CIMNE publications received close to 4,600 citations to their work, according to Scopus. In 2025, CIMNE researchers have taken part in **95 RTD projects** funded by international (**29 projects**) and Spanish (**66 projects**) organisations, which have meant **funding of 4.4 M€** for CIMNE. In the same period, CIMNE had **115 RTD contracts** with companies and private organisations, amounting to some **3.9 M€**. CIMNE has implemented a self-sustainable financial model with limited annual public funding. This has been possible by combining public seed funding (mainly from the Catalan Government) with income from RTD projects sponsored by public and private organisations, dissemination activities, revenues from CIMNE spin-off companies and an efficient management structure. In 2025, the self-obtained income obtained by CIMNE amounted (on average) to some **80% of its total annual budget**. Details of the sources of CIMNE funding in 2025 and in recent years can be found on **page 25.**

I thank CIMNE staff and its many partners and friends in universities, research centres and industry worldwide for their cooperation that contributes to making CIMNE a centre of reference in its field.

Prof. Javier Bonet
General Director

CIMNE Scientific Advisory Council

The Scientific Advisory Council (SAC) of CIMNE is composed of renowned international researchers in the field of numerical methods in engineering. These multidisciplinary experts advise the Executive and Governing Council on the centre's scientific policy and research priorities.

Prof. Peter Wriggers
Leibniz University
Hannover, Germany
SAC Chair

Prof. **Francisco Chinesta**
ENSAM
Paris, France

Prof. **Laura De Lorenzis**
ETH
Zurich, Switzerland

Prof. **Josef Eberhardsteiner**
Universität Wien
Vienna, Austria

Prof. **Pär Jonsen**
Luleå University
Luleå, Sweden

Prof. **Michal Kleiber**
Polish Academy of Sciences
Poland

Prof. **Rainald Löhner**
George Mason University
Fairfax, VA, USA

Prof. **Manolis Papadrakakis**
National Technical University
Athens, Greece

Prof. **Estefanía Peña**
University of Zaragoza
Zaragoza, Spain

Prof. **Umberto Perego**
Politecnico di Milano
Milan, Italy

Prof. **Simona Perotto**
Politecnico di Milano
Milan, Italy

Prof. **Ekkehard Ramm**
Stuttgart University
Stuttgart, Germany

Prof. **Bernard Schrefler**
Pavoda University
Padova, Italy

Prof. **Spencer Sherwin**
Imperial College
London, United Kingdom

Prof. **Karen Veroy**
Eindhoven University
Eindhoven, The Netherlands

Prof. **Karen Willcox**
Oden Institute
Austin, TX, USA

Prof. **Roland Wuchner**
Technical University of Braunschweig
Braunschweig, Germany

Senior Distinguished Researchers

CIMNE is honoured to have 11 esteemed professors as senior members of its research community. These distinguished academics bring exceptional intellectual reputations and international recognition in fields relevant to CIMNE, ensuring research excellence and intergenerational knowledge transfer. This honorary position reinforces CIMNE's scientific leadership and enhances collaboration with other leading institutions.

Research Cluster
Research Group

Prof. **Eduardo Alonso**
Geomechanics and Hydrogeology
Geomechanics

Prof. **Mª del Carmen Andrade**
Structural and Particle Mechanics
Structural Mechanics

Prof. **H. Alejandro Barbat**
Structural and Particle Mechanics
Disaster Risk and Resilience

Prof. **Jordi Corominas**
Geomechanics and Hydrogeology
Geomechanics

Prof. **Antonio Gens**
Geomechanics and Hydrogeology
Geomechanics

Prof. **Sergio R. Idelsohn**
Structural and Particle Mechanics
Structural Mechanics

Prof. **Juan Miquel**
Structural and Particle Mechanics
Structural Mechanics

Prof. **Fco. Javier Oliver**
Mechanics of Advanced Materials and Metamaterials
Computational Design & Analysis of Engineering Metamaterials

Prof. **Sergio H. Oller**
Structural and Particle Mechanics
Disaster Risk and Resilience

Prof. **Eugenio Oñate**
Structural and Particle Mechanics
Structural Mechanics

Prof. **Jaques F. Periaux**
Aeronautical, Marine, Automotive and Energy Engineering
Aeronautics


CIMNE

Organization Chart

GOVERNING COUNCIL
Chair: **Sílvia Paneque i Sureda**

EXECUTIVE COUNCIL
Chair: **Ferran Falcó / Pedro Díez**

ADVISORY SCIENTIFIC COUNCIL
Chair: **Peter Wriggers**

MANAGING BOARD

GENERAL DIRECTOR
Chair: **Javier Bonet**

SCIENTIFIC DIRECTOR
Pedro Díez
Sebastià Olivella

PROJECT DEVELOPMENT DIRECTOR
Fernando Salazar
Jordi Jiménez

INSTITUTIONAL RELATIONS DIRECTOR
Gabriel Bugeda

MANAGING DIRECTOR
Anna Font

MANAGEMENT TEAM
Mª Carmen Linares
Irene Martínez
Sandra Pérez

RESEARCH

RESEARCH CLUSTERS

Geomechanics and Hydrogeology
Contact point: Sebastià Olivella

Machine Learning and Models in Hydro-Environmental Engineering
Contact point: Fernando Salazar

Aeronautical, Marine, Automotive and Energy Engineering
Contact point: Xavier Martínez

Solid and fluid simulation for Industrial Processes
Contact point: Ramon Codina

Computational Mechanics in Medical Engineering and Living Matter
Contact point: Eduardo Soudah

Structural and Particle Mechanics
Contact point: Javier Bonet

Mechanics of Advanced Materials and Metamaterials
Contact point: Juan C. Cante

Credible High-Fidelity and Data-Driven Models
Contact point: Matteo Giacomini

Large Scale Multiphysics Computations
Contact point: Riccardo Rossi

INNOVATION UNITS

Innovation Unit in Transport (CENIT)
Contact point: Sergi Saurí

Innovation Unit in Building, Energy and Environment (BEEGroup)
Contact point: Jordi Cipriano

Innovation Unit in Pre, Post and Digital Technologies (DIGIT)
Contact point: Abel Coll

UNESCO CHAIR

UNESCO Chair in Numerical Methods in Engineering (CIMNE - UPC)
Michael Ortiz

TECHNOLOGY DEVELOPMENT

Tech Transfer & Innovation
Jordi Jiménez

Proposal Develoment
Jordi Jiménez

CIMNE Tecnología
Javier Marcipar

RESEARCH SUPPORT

Communication
Josep A Palacios

Congress Bureau
María del Mar Santiago

Finances
Mª Carmen Linares

People
Irene Martínez

Project Management
Francisco José de la Rosa

General Services
Assistant: Berta Claramunt
IT Development: Javier Tous
IT Services: Miguel Alonso
Publications: María Jesús Samper
Quality: Ignacio Valero
Receptionist: Jordi López / Rosa Alonso

Research

Our Research Challenges

At CIMNE, we have identified five themes that guide and inform our research efforts, based on local and global priorities, and pressing societal needs. We work alongside cross-cutting experts and institutions to develop a leading scientific research programme for a sustainable and equitable future.

Our priorities

Adaptation to Climate Change

- Assessment of induced damage, risk of extreme events
- Protection of costs against floods and droughts
- Infrastructure assessment and adaptation
- Sustainable and resilient land management

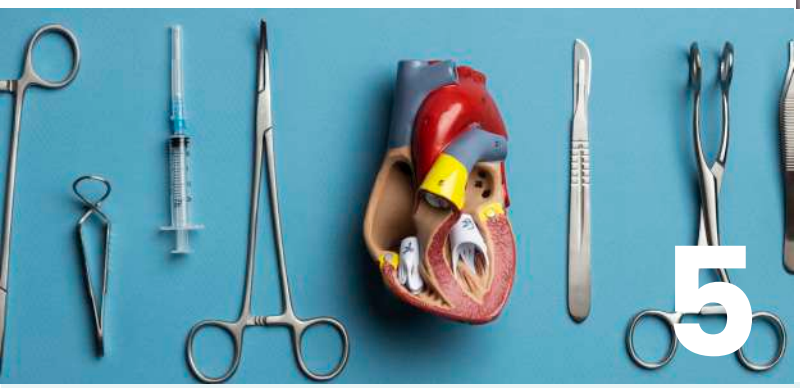
Mobility, cities, and territory

- Transport and civil infrastructure
- Cities and urban mobility
- Transport and logistics systems
- Aerospace and vertical mobility
- Maritime transport
- Automobile transport
- Sustainable and resilient land management

Energy and the environment

- Renewable energies
- Materials for energy
- Fusion, treatment of nuclear waste
- Energy conversion technologies
- Energy efficiency and distribution
- Water production, storage, treatment, and distribution
- Air, water, and land pollution

Industrial processes
- Advanced and innovative manufacturing
- Automation and optimisation of industrial processes
- Emerging materials: metamaterials
- Intelligent construction



Health
- Modelling of biosystems and biomaterials
- Patient-centred approaches to detect and predict disease
- Medical devices
- Biological systems
- Mechanobiology

Our motivation

CIMNE research priorities are driven by multiple external impulses.

UN 17 Sustainable Development Goals

The 5 EU Missions

Spanish Government Strategic Lines

R+D Themes of the Catalan Government

Our Research Methodologies

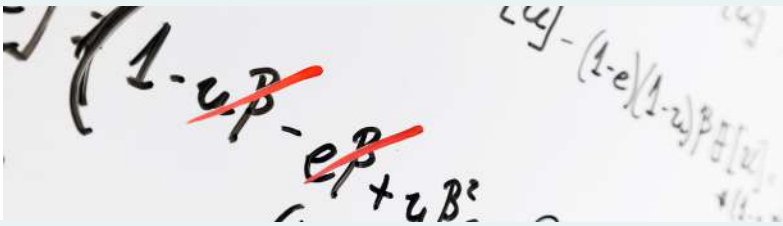
We use state-of-the-art cross-cutting technologies within the field of numerical methods and computational modelling to tackle pressing societal issues.

Discretization Techniques

- Innovative approaches in meshing methods
- Particle and meshfree methods
- Unfitted methods
- Techniques for coupledproblems
- Error assessment and adaptability
- Geometry and simulation representation

Physical and Mathematical Models

- Constitutive formulations
- Models of materials for multiphysical and multiscale phenomena
- Innovative variational formulations
- Optimisation
- Models based on agents or subjects

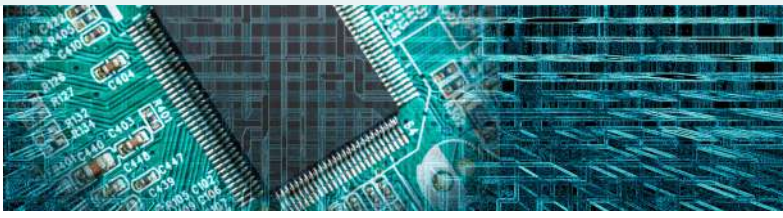


Data-driven Models

- Science based Machine Learning and Artificial Intelligence
- Reduced order modelling
- Inverse methods
- Big data management
- Uncertainty Quantification
- Digital Twins
- Geometry and simulation representation

High Performance Computational Models

- Domain decomposition and preconditioning
- Emerging architectures (e.g. quantum computing)
- New coding paradigms



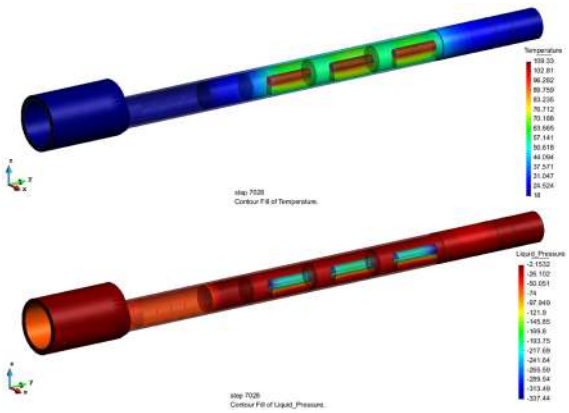
Research and Innovation

CIMNE is organised into nine research clusters and three innovation units. The clusters promote cutting-edge research in areas of interest to CIMNE. Innovation units focus on applied research, combining cutting-edge discovery with technology transfer solutions.

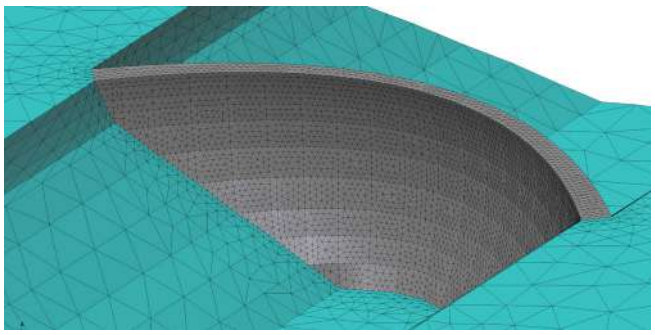
Research Clusters

Geomechanics and Hydrogeology

The Geomechanics and Hydrogeology Research Cluster at CIMNE advances fundamental understanding and computational modelling of soil and rock behaviour, focusing on coupled thermal, hydraulic, mechanical, and chemical (THMC) processes in porous media. The cluster develops cutting-edge numerical tools and experimental methods to support the design and analysis of underground structures, rockfill dams, and fluid–soil–structure interaction challenges. Its expertise extends to applications such as groundwater management, aquifer studies, nuclear waste disposal, and large-scale geotechnical engineering projects, contributing to both scientific innovation and practical engineering solutions.



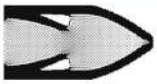
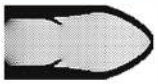
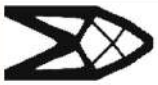
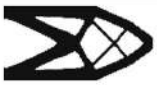
Machine Learning and models in Hydro-Environmental Engineering



The main activity of this cluster is related to hydraulic and hydrological engineering. To solve practical problems, the cluster combines physically based numerical models, data-driven machine learning models and laboratory tests. Its activities also include participation in projects in other areas, such as railway ballast, landslides, optimisation of advanced wastewater disinfection processes or air quality prediction. Its activities include research, consultancy, training, and technology transfer.

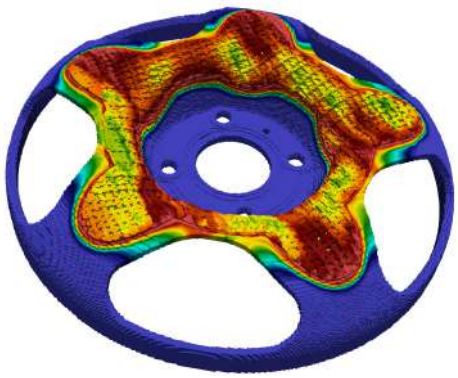
Aeronautical, Marine, Automotive and Energy Engineering

The cluster focuses on the development of numerical models to address problems in the fields of aerospace, oceanic and marine engineering, automotive, and energy. These problems may involve structural analysis, fluid-structure interaction, and/or optimisation of behaviour and performance. Recent developments from the group include the creation of digital models for ocean energy converters, the development of formulations for simulating composite materials, topological optimisation, the creation of fatigue simulation algorithms for materials, and the development of optimisation algorithms to assist decision-making in air traffic management.

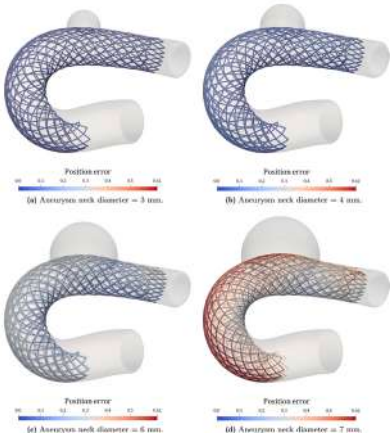
	Case (A) $E_0 = 10^{-3}$ $E_1 = 1$ $\nu_0 = 1/3$ $\nu_1 = 1/3$	Case (B) $E_0 = 10^{-3}$ $E_1 = 1$ $\nu_0 = 1/3$ $\nu_1 = 0$	Case (C) $E_0 = 10^{-3}$ $E_1 = 1$ $\nu_0 = 1/3$ $\nu_1 = -0.5$	Case (D) $E_0 = 10^{-3}$ $E_1 = 1$ $\nu_0 = 1/3$ $\nu_1 = -0.75$	Case (E) $E_0 = 10^{-3}$ $E_1 = 1$ $\nu_0 = 1/3$ $\nu_1 = -0.9$
SIMP interpolation	 $J = 1.592$, $J_{SA} = 1.548$, Iter = 212, FE eval = 214, KKT norm = 8.79×10^{-5}	 $J = 1.616$, $J_{SA} = 1.607$, Iter = 152, FE eval = 154, KKT norm = 9.66×10^{-5}	 $J = 1.694$, $J_{SA} = 1.703$, Iter = 5000, FE eval = 5002, KKT norm = 1.06×10^{-3}	 $J = 1.779$, $J_{SA} = 2.239$, Iter = 4201, FE eval = 4203, KKT norm = 8.30×10^{-4}	 $J = 1.674$, $J_{SA} = 2.988$, Iter = 1870, FE eval = 1872, KKT norm = 8.72×10^{-4}
Adaptative SIMP interpolation	 $J = 1.592$, $J_{SA} = 1.548$, Iter = 212, FE eval = 214, KKT norm = 8.79×10^{-5}	 $J = 1.638$, $J_{SA} = 1.613$, Iter = 219, FE eval = 220, KKT norm = 8.26×10^{-5}	 $J = 1.784$, $J_{SA} = 1.737$, Iter = 116, FE eval = 117, KKT norm = 8.26×10^{-5}	 $J = 2.322$, $J_{SA} = 2.263$, Iter = 393, FE eval = 394, KKT norm = 9.87×10^{-5}	 $J = 2.974$, $J_{SA} = 2.898$, Iter = 1674, FE eval = 1675, KKT norm = 3.90×10^{-5}
SIMP-ALL interpolation					

Solid and fluid simulation for Industrial Processes

The cluster focuses on industrial process modelling, including fluid mechanics simulation and thermo-mechanical simulation. In fluid mechanics, the group studies high-speed flows, turbulence, porous media, aeroacoustics and coupled problems such as magnetohydrodynamics, using advanced numerical methods such as stabilised finite elements, reduced models and parallel computing. In thermo-mechanics, the group develops nonlinear analysis tools with various element formulations and constitutive laws, applied to additive manufacturing, friction stir welding and 3D printing of concrete.



Computational Mechanics in Medical Engineering and Living Matter



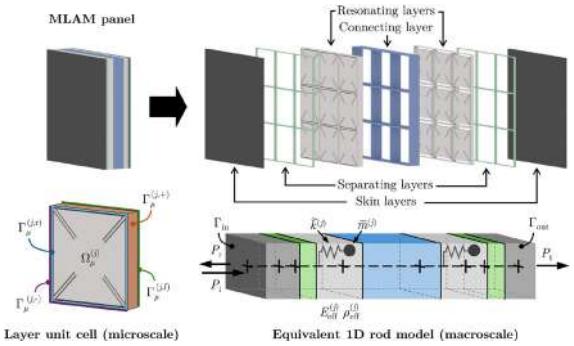
This cluster develops advanced computational methods to model, predict, and analyse the mechanical behaviour of biological systems across multiple scales. Its main objectives are to understand the evolution of tissues and organs, simulate pathological and therapeutic processes, and optimise the design and assessment of medical devices. The main research lines of the cluster include: 1) Biomechanical modelling of tissues and organs, 2) Investigation of pathologies and the development of simulation-based therapeutic strategies, 3) Mechanical and functional analysis of biomaterials and biological systems for medical engineering, and 4) Design and validation of safer, more efficient, and personalised medical devices. Researchers in the cluster develop theoretical and computational models to study complex biological interfaces, ranging from cellular mechanobiology to tissue-level behaviour. These tools enable quantitative characterisation of biological systems, support the rational manipulation of active living materials, and foster the design of innovative bionic materials for biomedical applications, including the analysis of the mechanical behaviour of organs and medical devices.

Structural and Particle Mechanics

The Structural and Particle Mechanics cluster at CIMNE specializes in advanced computational methods for solving complex multidisciplinary mechanical and structural challenges. The cluster develops predictive technologies for analysing structural systems under dynamic conditions and multiphysical interactions using a variety of innovative techniques that combine Finite Element Methods (FEM) with particle-based techniques, such as the Discrete Element Method (DEM), Particle Finite Element Method (PFEM), Smooth Particle Hydrodynamics (SPH) and others. Their research spans diverse engineering domains, including civil, aerospace, marine, transportation, and energy infrastructure. The cluster focuses on sophisticated computational approaches that integrate sensor information, artificial intelligence (AI), and real-time simulation to model intricate phenomena such as thermo-mechanical coupling, fluid-structure interaction, and friction contact effects. Emerging research directions include extending computational methods for nonlinear structural electro and magneto active mechanics, developing novel conservation formulations, and creating advanced dynamic fracture models. By leveraging digital modelling technologies and emerging computational techniques, the cluster aims to enhance structural safety predictions, optimise design solutions, and ensure sustainable structural integrity across multiple engineering sectors.

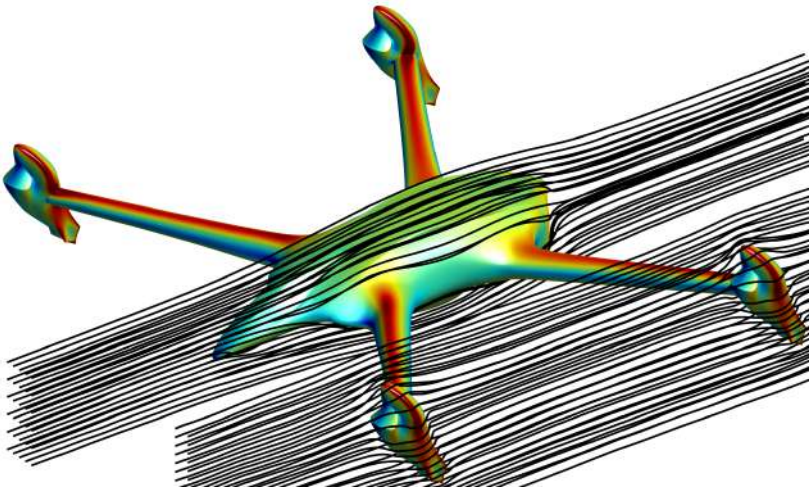
Mechanics of Advanced Materials and Metamaterials

The Mechanics of Advanced Materials and Metamaterials Research Cluster at CIMNE specialises in composites and advanced materials with enhanced properties, which require specific formulations for effective multiscale analysis and characterisation. The cluster has a strong tradition of developing numerical strategies for analysing composite materials made from fibres embedded in matrix systems, ranging from enhanced versions of mixing theory to more advanced multiscale methods. Its work includes plasticity and damage, fibre-metal laminates, reinforced and prestressed concrete, topologically optimised materials, and fatigue analysis, all approached through comprehensive multiscale analysis techniques. Additionally, the cluster focuses on the design of metamaterials with extreme acoustic, mechanical, and electromagnetic properties, targeting innovative engineering applications.



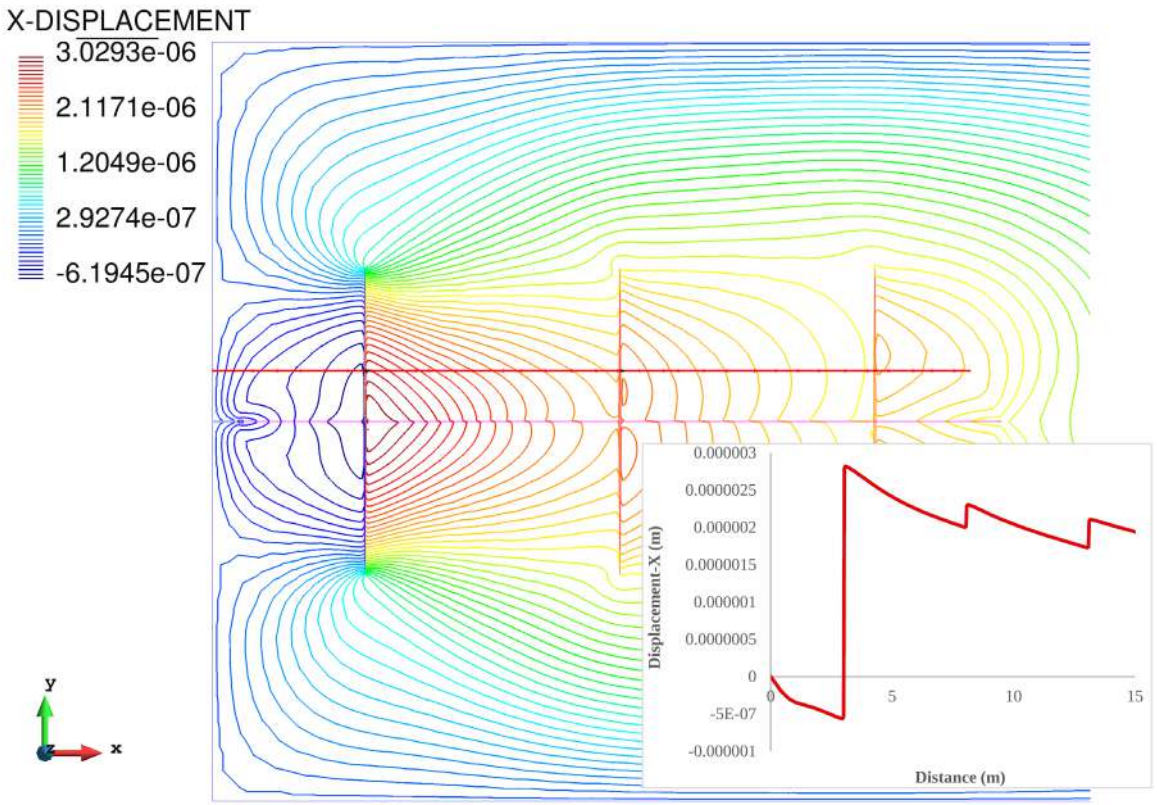
Credible High Fidelity and Data Driven Models

CIMNE's Credible High-Fidelity and Data-Driven Models Research Cluster is dedicated to developing innovative mathematical and computational approaches that advance quantitative and predictive capabilities in science and engineering. It integrates rigorous physical models with rich data sources from numerical simulations, laboratory experiments, and real-world observations to create robust predictive frameworks. A core focus of its work is to advance the state-of-the-art in modelling complex phenomena arising in industrial production and sustainable development. This is achieved by formulating models based on partial differential equations and data-driven descriptions and by developing novel computational methods for their numerical simulation.



Large Scale Multiphysics Computations

The Large Scale Multiphysics Computations Research Cluster at CIMNE integrates cutting-edge expertise in the development and application of advanced numerical methods for solving complex multiphysics problems. This represents an integrative effort between two specialised research groups: Kratos Multiphysics and Intelligent Multiphase Modelling in Microsystems (IM³). By merging state-of-the-art capabilities across diverse fields, the cluster pioneers the integration of multiphysics models into a unified workflow, enhancing the versatility of the open-source Kratos framework. Additionally, the cluster brings specialised expertise in computational fluid dynamics for microfluidic systems. This research addresses increasingly complex engineering challenges for direct application in industry and societal burdens while maintaining a collaborative approach and a commitment to open-source solutions.



Innovation Units

Transport (CENIT)

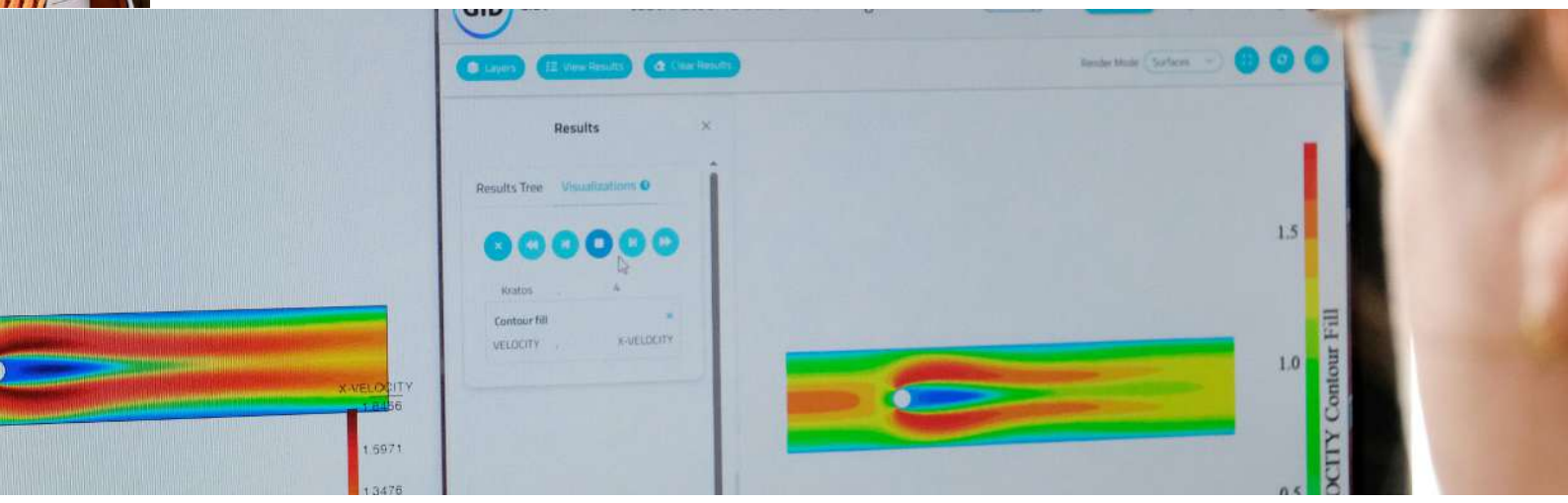
The Innovation Unit in Transport (CENIT) aims to help find sustainable and innovative solutions for transport and mobility. The unit has extensive experience in research, development and technology transfer projects, both at the local and global level. Its main lines of research are: urban mobility, logistics and maritime transport, and the management and financing of transport infrastructures. CENIT's multidisciplinary team has extensive experience in systems modelling and methodological development based on the foundations of operational research and economic behaviour. In addition to R&D activities, CENIT also organises courses and seminars aimed at professionals seeking to update their specific technical knowledge and learn about the latest developments in the transport sector.

Pre, Post, and Digital technologies

CIMNE's Innovation Unit in Pre, Post, and Digital Technologies (DIGIT) pioneers advanced simulation and digital integration through software engineering. It develops cutting-edge methods for efficient data generation and visualization of computational results, anchored by expertise in the GiD universal pre- and post-processing environment for numerical simulations. The unit seamlessly combines this technical foundation with state-of-the-art digital tools such as Artificial Intelligence, IoT platforms, GIS, Blockchain, and modern web technologies. By leveraging deep learning and computer vision techniques, it transforms complex, high-dimensional real-world data into actionable insights, driving innovative decision support systems and fostering advancements across diverse engineering disciplines.

Building, Energy, and Environment (BEE Group)

The Building, Energy and Environment (BEE) Group, founded in 2001 within CIMNE, comprises about 30 researchers. BEE Group has two main offices: one in the GAIA building on the UPC Campus in Terrassa and the other in the Agrobiotech Park in Lleida. BEE Group leads innovative solutions to decarbonise buildings and enhance cities' climate resilience through data-driven methodologies. BEE Group's R&D activities focus on enhancing energy flexibility with predictive control and optimised storage in smart buildings and grids, developing data-driven processing and models to improve the management and decarbonization of large building portfolios, implementing geospatial artificial intelligence (GeoAI) to build a more resilient future for cities with accelerated spatial problem-solving, and engineering of low-cost digesters as a widespread biogas technology for various climates.



CIMNE in Numbers (2025)

Research

193
publications
66% of which under Open Access
16% of which with Industry Partners

12
awards

Tech Transfer

11
Patents in force

115
Contracts
with industry

7
Spin-offs and start-ups with CIMNE Technology

€3.94 M income
from products made at CIMNE

Training

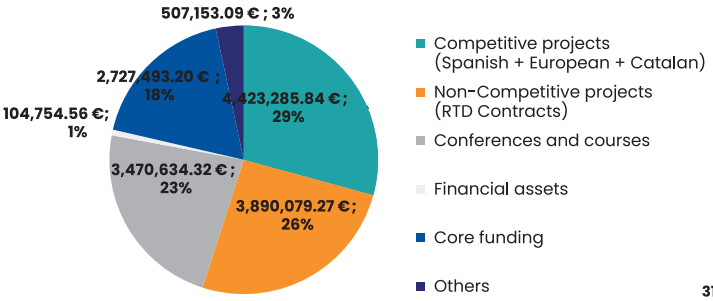
28
PhD Theses Defended

3
postgraduate studies offered with UPC

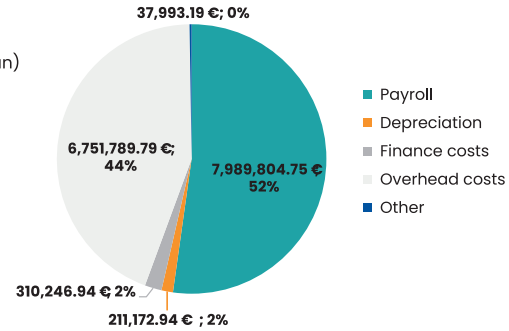
- Master on Numerical Methods in Engineering
- PhD Degree in Civil Engineering
- PhD Degree in Structural Analysis

Resources

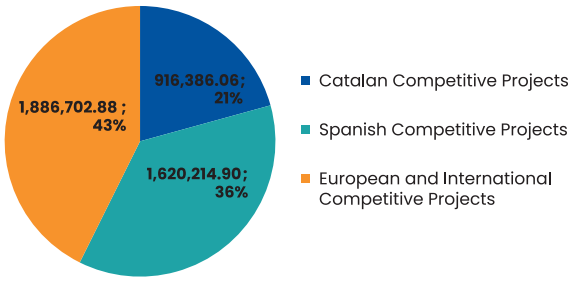
Revenue



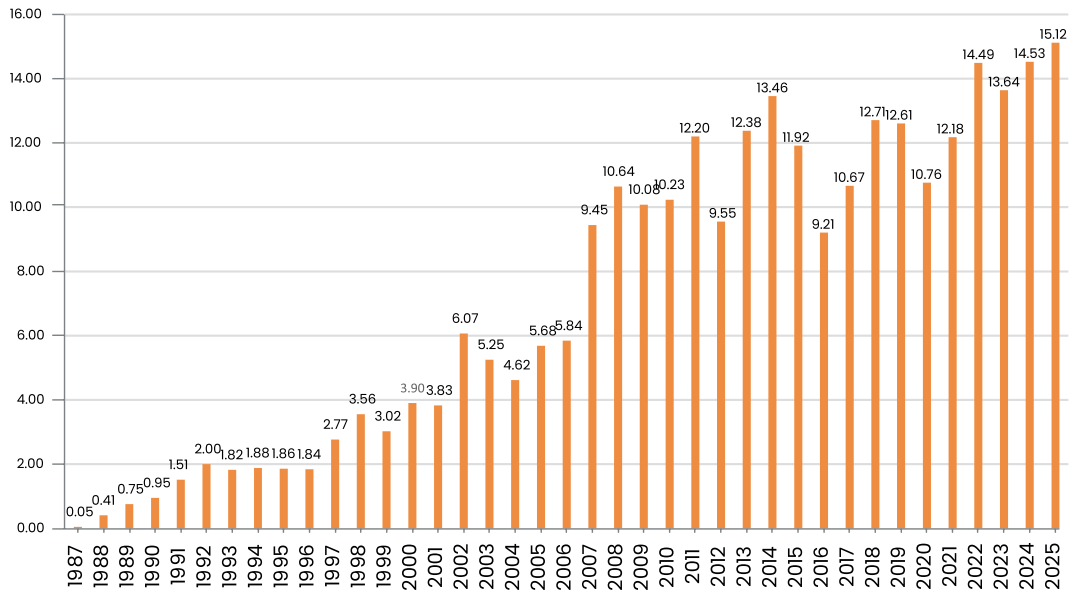
Expenses



Competitive Projects



Evolution Annual Revenue

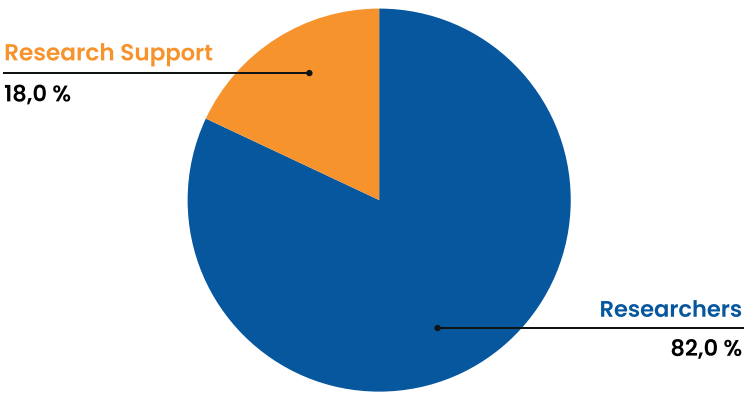


Talent

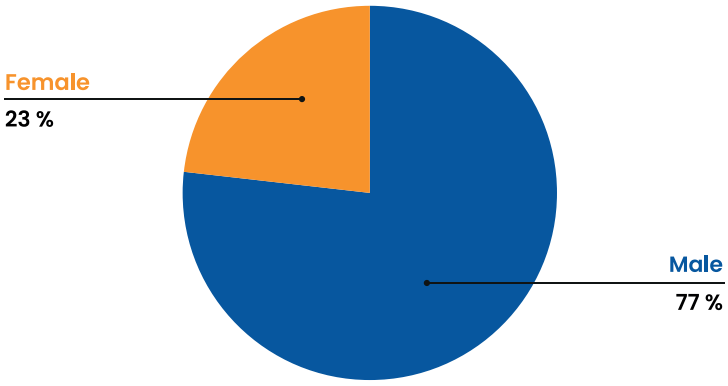
250
People
as of Dec 31, 2025

90
Positions offered in 2025
including admin staff, research positions, and student opportunities

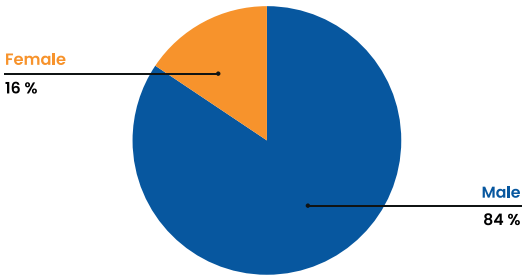
Role



Gender



Researchers



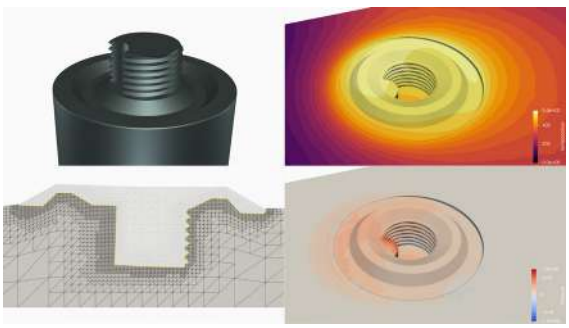
Research Impact

Driving Tech Transfer for Industrial Innovation

CIMNE Showcases Advanced Engineering Solutions at Advanced Factories 2025

CIMNE took part in Advanced Factories 2025, one of Europe's leading events on automation, digitalisation and advanced manufacturing, held in Barcelona from 8 to 10 April. The event provided an excellent opportunity for the centre to present its latest technological developments and strengthen links with industry stakeholders interested in advanced computational engineering solutions.

Led by CIMNE's Innovation and Tech Transfer Unit, the centre's delegation showcased a broad portfolio of technologies in simulation, artificial intelligence and advanced manufacturing, with applications across multiple industrial sectors. Visitors to CIMNE's stand were able to learn first-hand about innovative solutions ranging from intelligent control in additive manufacturing and high-performance simulation for welding processes to digital twins, smart monitoring platforms and advanced materials design.



CIMNE's participation also opened the door to new opportunities for collaboration and knowledge transfer. During the congress, the team engaged with leading companies and organisations such as SEAT S.A., Repsol, Mercedes-Benz AG, Sateliot, Eurecat and many others, generating promising contacts for future joint initiatives in technology development and industrial innovation.

The centre's presence at Advanced Factories 2025 reaffirmed its commitment to bringing cutting-edge research closer to real-world industrial challenges. It also served to showcase the work of CIMNE's technology transfer teams, whose efforts help align the centre's scientific and technical expertise with the needs of companies and strategic sectors.


CIMNE
Digital simulation tools for Real advanced manufacturing
Smarter design tools: right-first-time manufacturing
Advanced intelligence for real-world machines
AI-driven control in real time: efficient manufacturing without delays
Eco-design for lightweight, strong, and performance-optimized components
Innovation in composites and metamaterials with advanced computational intelligence
CIMNE

Success stories

Transforming Metal Casting Through User-Centred Simulation

CIMNE's research in casting simulation has generated substantial industrial and economic impact through **Click2Cast**, a technology for simulating aluminium casting and injection processes. **Click2Cast** was developed and industrialised through Quantech, a CIMNE spin-off, and has been marketed into the global engineering software market.

The research underpinning this technology focused on developing and implementing a sophisticated multiphysics finite-element code to simulate the interconnected fluid dynamics, thermal, and mechanical processes involved in mould filling and aluminium injection. This work also established a strong scientific foundation, with CIMNE researchers contributing **15 publications** in JCR-indexed journals.

Click2Cast became one of **QUANTECH**'s flagship software products and a clear example of successful technology transfer from research to industry. Through licensing and contract fees, CIMNE received incomes from Quantech, while participation in research and development projects led by the company generated substantialn additional revenue.

The software's core features support a broad range of applications, from design to engineering, and the market-oriented simulation environment features a user-friendly, innovative interface. In 2015, Click2Cast expanded to new horizons when the North American company **Altair** acquired the product. Since then, the software has achieved broad international adoption, being used in more than 18 countries by leading firms in the automotive, heavy machinery, and aeronautics sectors.

The product's ongoing evolution is reflected in Click2Cast's incorporation in Altair's Inspire Cast. The 2025 release has introduced new analysis, automation, and optimisation capabilities, showing that the original technology remains active within a major international software platform. Together, these advances demonstrate how CIMNE-originated research has continued to evolve inside a global software product, delivering long-term value to industrial users worldwide.

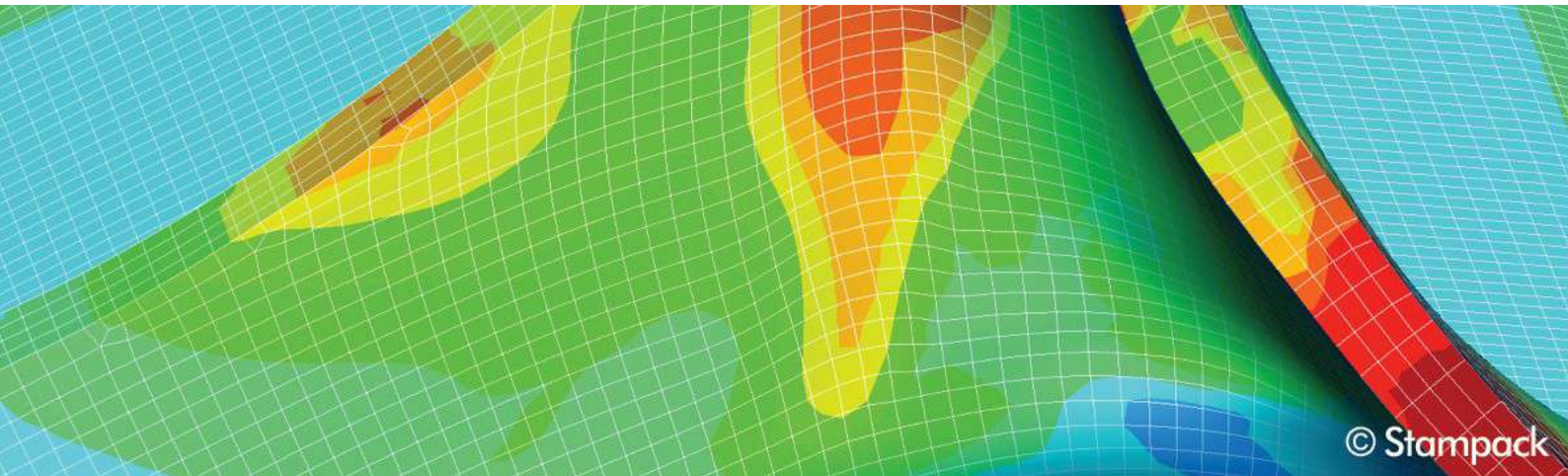
Advancing Sheet Metal Forming Simulation for Global Industry

CIMNE's research on computational plasticity and sheet metal forming has achieved significant scientific, technological, and commercial impact through **Stampack**, a product developed and marketed through **QUANTECH**, a CIMNE spin-off. This simulation technology is based on an advanced explicit finite element code designed to accelerate and simplify highly dynamic impact and contact processes between sheet metal and steel parts. This research line has produced a substantial academic output, including **42 publications** in JCR-indexed journals.

Stampack has achieved broad international adoption, being used in more than 30 countries by leading companies in the automotive, aerospace, defence, metal packaging, and other industrial sectors. CIMNE also benefited directly from this technology transfer through its participation in research and development projects led by **QUANTECH**, generating consistent revenues. These outcomes reflect how advanced numerical methods developed in a research environment can be translated into practical industrial software with a broad global reach.

More recently, the technology achieved even greater international validation with its acquisition by **AutoForm Group** in 2025. The acquisition expands AutoForm's capabilities in automotive, aerospace, household appliances, electrical industries, and additional fields where explicit and solid-element simulation are particularly important.

CIMNE's Innovation Unit **DIGIT** continues to contribute expertise in this field through collaboration on the development of advanced mesh-smoothing techniques. Since 1987, CIMNE has also organised 17 conferences on Computational Plasticity, where successive developments linked to Stampack have been presented.



UNESCO Chair

CIMNE's UNESCO Chair Professor Michael Ortiz reflects on the future of scientific computing

On 28 October 2025, Professor Michael Ortiz delivered the seminar *"Science Meets Data: Scientific Computing in the Age of Artificial Intelligence"* at Palau Robert (Barcelona). The event marked his appointment as Chairholder of the UNESCO Chair in Numerical Methods in Engineering at the Polytechnic University of Catalonia (UPC) and CIMNE, and brought together researchers and professionals interested in how computation, data and new paradigms are reshaping engineering.

The UNESCO Chair in Numerical Methods in Engineering—established in 1989—was the first UNESCO Chair worldwide dedicated to advancing numerical methods in engineering. Its mission is to foster international research, education and technology transfer to address complex engineering challenges, with a particular commitment to technical training and knowledge dissemination in lower-income countries.

Professor Ortiz, internationally recognised for his contributions to computational mechanics, has built a distinguished academic career at leading institutions, including Caltech and Stanford University. As Chairholder, he is spearheading strategic research lines at CIMNE in data-enriched simulation and quantum computational mechanics.
A central theme of the seminar was the scientific shift driven by the explosion of data and the rapid maturation of artificial intelligence. Professor Ortiz emphasised that data do not automatically generate understanding: without structure, interpretation and physical principles, large volumes of information can become noise. In engineering mechanics—where governing equations, models and conservation laws provide a rigorous framework—data should be used to complement physics, enabling more realistic predictions for complex materials and systems that resist classical description.

Advances in numerical simulation, hybrid approaches and emerging quantum techniques are opening new pathways to model materials and structures at unprecedented levels of detail, including phenomena governed by atomic-scale processes. In this context, Professor Ortiz highlighted the importance of integrating classical simulation, experimental evidence and advanced computation to expand predictive capabilities. By hosting this seminar under the UNESCO Chair, CIMNE reaffirmed its commitment to research that combines scientific rigour with innovation and global impact.

Corporate News

Catalan Government Approves New Performance Contract with CIMNE

The Catalan Government approved a new funding agreement for CIMNE for the 2025-2028 period, establishing €11.4 million in funding for the centre's research, development, and innovation activities.

The new Performance Contract provides €8.3 million from the Catalan Department of Territory, Housing and Ecological Transition, and €3.1 million from the Department of Research and Universities. This baseline funding will provide financial stability for CIMNE, aimed at reinforcing the centre's leadership in computational modelling for the social good.

The agreement defines four strategic objectives for the foreseeable years, mandating the development of a world-leading research programme, recruitment of top-tier global talent, strengthen institutional partnerships for the centre, and direct social impact through technology transfer.

This agreement upholds CIMNE's research agenda and its five thematic areas: climate change adaptation; mobility, cities and territory; energy and environment; industrial processes; and health. The contract establishes a monitoring framework with 30 indicators assessed annually by a Follow-up Commission comprising representatives from the funding departments, the I-CERCA Foundation, and CIMNE.

Prof. Javier Bonet, General Director of CIMNE, believes this financial support "represents a firm commitment to the applied engineering research" at CIMNE. "This milestone encourages us to continue working with the objective of developing high-level computational engineering research with direct impact on society", said Prof. Bonet.

The contract incorporates provisions for additional extraordinary funding through project addenda and formalises knowledge transfer between CIMNE's Centre for Innovation in Transport and the Catalan Department of Territory, allocating researcher time and funding for infrastructure digitalisation, mobility decarbonisation, air quality modelling, and coastal modelling.

CIMNE Renews TECNIO Accreditation as a Leading Technology Developer until 2028

CIMNE successfully renewed its TECNIO accreditation for 2025-2028, granted by ACCIÓ, the Catalan Agency for Business Competitiveness. An independent evaluation board confirmed the centre as a cutting-edge technology developer in Catalonia's innovation ecosystem.

Specifically, the TECNIO seal acknowledges CIMNE's expertise in transferring research to industry partners, emphasizing ready-to-market solutions with local and societal impact.
The TECNIO seal was granted as part of the centre's strategy to advancing technology transfer in climate change adaptation, healthcare innovation, advanced manufacturing, sustainable urban development, and green energy transition.

This distinction underpins CIMNE's Research Impact Strategy and its Technology Transfer Roadmapping, both developed in partnership with local and global industry and academia stakeholders.

CIMNE Charts Future Course Through Strategic Roadmapping Exercise

A CIMNE delegation visited the office of the Catalan Agency for Business Competitiveness (ACCIÓ) in Brussels, Belgium to strengthen collaboration and explore technology transfer opportunities. The meeting focused on identifying European partnerships and addressing industrial challenges in engineering and applied sciences.

The working visit allowed CIMNE to explore innovation opportunities and better understand the needs of Catalan business abroad. Following CIMNE's Research Impact Strategy and Technology Transfer Roadmapping, experts from the centre discussed industrial priorities, funding opportunities and connections with industry partners abroad. CIMNE's Technology Development department is solely dedicated to high-impact innovation. This department comprises three specialised units focusing on technology valorisation and transfer, proposal development, and business incubation.

CIMNE and CTFC formalise collaboration to boost joint research and knowledge transfer

The International Centre for Numerical Methods in Engineering (CIMNE) and the Forest Science and Technology Centre of Catalonia (CTFC) signed a collaboration agreement to strengthen joint research, innovation and knowledge transfer in the fields of forests, bioeconomy and territorial sustainability.

The alliance bridges CIMNE's expertise in numerical methods and computational engineering with CTFC's role as a CERCA institute and reference centre in forest science and technology in Catalonia.

The agreement provides a framework for developing collaborative projects, promoting shared use of scientific infrastructures and advancing training activities for researchers and technical staff. CTFC, a research centre attached to the Government of Catalonia and accredited as a TECNIO technology developer, specialises in applied forest research and it is a key partner in multiple European and international networks.

"This collaboration opens up new opportunities to apply cutting-edge computational tools to address environmental and territorial challenges," stated CIMNE General Director Prof. Javier Bonet.

CIMNE signs strategic alliance in advanced materials research with IMDEA Materials

CIMNE and the Madrid-based IMDEA Materials Institute signed an ambitious framework agreement to strengthen collaboration in engineering materials and numerical simulation.

The alliance, formalised in October 2025, consolidates a long-standing relationship that dates back to the early years of IMDEA Materials, when Prof. Eugenio Oñate, founding director of CIMNE and now President of the IMDEA Materials Board of Trustees, joined its Scientific Council.

The agreement establishes broad cooperation in research, methodological development and knowledge transfer, with a focus on structural analysis, modelling and innovative solutions for advanced materials and manufacturing processes. Joint initiatives include co-directed PhD theses, shared use of singular scientific infrastructures, staff and student mobility, and the organisation of scientific events.

According to CIMNE's General Director, Prof. Bonet, this collaboration represents "a strategic alliance that connects advanced computational research with innovation in materials science", and enables the development of "cutting-edge solutions aligned with European research priorities."

CIMNE and Chinese Aeronautical Establishment sign strategic MoU on Aeronautical Simulation

CIMNE and the Chinese Aeronautical Establishment (CAE) signed a Memorandum of Understanding (MoU) in September 2025 to establish a strategic framework for cooperation in aeronautics research and advanced numerical simulation.

The MoU, sealed at CIMNE's headquarters in Barcelona, provides for joint research projects in computational aerodynamics, aeroelasticity and structural analysis, as well as the co-development of simulation tools for aircraft design and certification.

The agreement also promotes the exchange of researchers and technical staff, participation in shared training activities and the organisation of scientific workshops to foster knowledge transfer between both institutions. CAE, which is a research organisation within the Aviation Industry Corporation of China (AVIC), will contribute its experience in aeronautical technology development and large-scale experimental facilities.

This agreement is part of CIMNE's broader efforts to internationalise its research and innovation in collaboration with leading industry partners.

Institutional Visit from AVIC Aircraft Outlines Avenues for Cooperation

A high-level delegation from AVIC Shenyang Aircraft Design and Research Institute visited CIMNE in October 2025 to learn from the centre's research in numerical simulation and explore venues for collaboration in aerospace engineering and advanced simulation.

Both entities vowed to strengthening ties and identifying potential joint research and innovation pathways in sustainable aircraft design and computational engineering. The delegation, led by AVIC's Xi Jixing, brought together 24 representatives from one of China's leading aeronautical institutions, who met with CIMNE's leadership and top researchers at a joint working meeting.

During the visit, CIMNE experts on advanced materials and structures for aerospace applications, numerical modelling of nonlinear solid mechanics, and fluid mechanics and industrial process simulation shared some of the centre's latest advancements with the Chinese delegation.

CIMNE Secures Extension for Structural Calculation Services of Nuclear Power Plants in Catalonia

CIMNE renewed its quality certification to provide engineering services for structural calculations to nuclear power plants operated by the Ascó-Vandellós Nuclear Association (ANAV), ensuring the continuous safe operation of critical energy infrastructure in Catalonia.

The certification, issued in November 2025 and valid until October 2028, verifies that CIMNE's quality management system meets the stringent requirements of the UNE 73401:1995 standard. The independent evaluation, documented in audit report C-CM9-005, validates the centre's technical and organisational capacity to deliver specialised structural calculations essential for the safe operation of ANAV's three nuclear reactors: Ascó I, Ascó II, and Vandellós II, located 100 km south of Barcelona.

These facilities collectively generate an average of 56% of Catalonia's electricity and contribute 10% of Spain's emission-free power generation. During the period from 2020 to 2023 alone, ANAV's operations prevented approximately 44 million tonnes of CO^2 emissions, equivalent to 34% of Spain's total carbon dioxide emissions from electrical generation.

CIMNE's work encompasses advanced analyses of reactor containment buildings, seismic resilience assessments, and failure pressure evaluations, all critical components in maintaining the stringent standards mandated by nuclear regulations. Experts from multiple research clusters at CIMNE take part in this endeavour, employing advanced numerical modelling and computational analysis techniques developed over decades of research and partnership. The centre's research has been particularly instrumental in supporting ANAV's transition to Long Term Operation (LTO), which extends the operational lifespan of nuclear facilities beyond their initial 40-year design period. Through scientific validation using advanced computational tools such as the PLCd code (PLastic Crack dynamic), CIMNE has helped demonstrate the continued structural integrity of ageing infrastructure, enabling ANAV to secure renewed operating licences from 2020 to 2030.

Advanced Engineering for Nuclear Safety

CIMNE's nuclear safety work extends beyond its partnership with ANAV. The centre has participated in international benchmarks such as Électricité de France's VeRCoRs project, where its numerical-experimental analyses have validated the performance of nuclear containment structures. Both the Spanish Nuclear Safety Council (CSN) and the International Atomic Energy Agency (IAEA) have verified and endorsed CIMNE's analyses, confirming their alignment with stringent international safety standards.

The partnership between CIMNE and ANAV, which began in the early 1990s, has also generated significant economic benefits, safeguarding 920 direct jobs at ANAV whilst enabling substantial investment in research and development for advanced engineering solutions. The renewal of this certification reinforces CIMNE's position as a trusted provider of critical engineering services to Spain's nuclear industry and demonstrates the centre's continued ability to meet the exacting standards required for work in this critical sector.


Jorge Franganillo/Wikimedia Commons

CIMNE Engages with Local Authorities to Face Societal Challenges

CIMNE received three ministerial visits from the Government of Catalonia during 2025, signifying the centre's strategic role in addressing societal challenges through computational engineering and technology transfer.

Catalan Ministers Núria Montserrat, Sílvia Paneque, and Miquel Sàmper visited CIMNE to explore how advanced numerical modelling can support public policy objectives across climate adaptation, sustainable mobility, energy, and territorial development.

In January, Núria Montserrat, Minister of Research and Universities, visited CIMNE's headquarters. Led by Director Javier Bonet and UPC Vice-Rector Climent Molins, discussions focused on computational research for climate change, sustainable mobility, green energy, and health.

March brought Miquel Sàmper, Minister of Business and Employment, accompanied by Oriol Alcoba, Director General for Industry. Discussions examined CIMNE's contributions to industrial innovation and support for Catalonia's business ecosystem, with UPC Rector Daniel Crespo and Esther Real, Director of the School of Civil Engineering.

In April, Sílvia Paneque, Minister of Territory, Housing and Ecological Transition, toured CIMNE, the Flumen Institute, and UPC's School of Civil Engineering. Minister Paneque met research teams working on digital technologies, aeronautical and energy engineering, and hydraulic dynamics. CIMNE, which operates under the Catalan Department of Territory, aligns its research priorities with local societal challenges including resilient infrastructure and territorial development.

CIMNE's research addresses climate change adaptation, mobility, energy and environment, industrial processes, and health using discretisation techniques, mathematical models, data-driven technologies, and high-performance computing.

Lasting relationship with local authorities

CIMNE keeps a long-standing working relationship with local authorities and has led multiple solutions for territorial management. Recent collaborations include PIKSEL, a tool for studying environmental phenomena with the Department of Territory; SAIT, a system for evaluating infrastructure investments; and a digital platform for monitoring slopes in mobility infrastructure.

These engagements position CIMNE as a partner in addressing Catalonia's technological and social challenges.

Professor Oñate Receives Spanish National Research Award

Professor Eugenio Oate, founding director of CIMNE, received the Spanish National Research Award 2024 in the Leonardo Torres Quevedo category in a ceremony in *El Pardo* Royal Palace in Madrid in July 2025. The ceremony was presided over by His Majesty King Felipe VI and Minister Diana Morant.

The award recognised Professor Oñate's career developing innovative numerical methods for structural mechanics, fluid dynamics, and coupled applications across civil, industrial, aerospace, marine, and naval sectors.
Professor Javier Bonet, CIMNE's General Director, represented the centre Professor Oñate founded in 1987. Under his leadership, CIMNE has become a global reference for numerical methods in engineering.

Professor Oñate has published over 467 articles with more than 14,000 citations, making him Spain's most cited civil engineer.

Dr. Mauricio Pohl visits CIMNE to Strengthen Central America Collaboration

Dr. Mauricio Pohl, Director of the UCA-CIMNE Lab at the Universidad Centroamericana José Simeón Cañas in El Salvador, visited CIMNE in 2025 to reinforce collaboration in research and technology dissemination.

Pohl, who has led the UCA-CIMNE Lab since 2010, met with CIMNE General Director Professor Javier Bonet, Institutional Relations Director Professor Gabriel Bugeda, and Dr. Francisco Zarate, Director of the International Association of CIMNE Labs. The UCA-CIMNE Lab collaborates on research including blockchain for electrical energy, IoT monitoring, river modelling, virtual and augmented reality, and climate risk modelling.

CIMNE Labs are physical spaces acting as joint laboratories for cooperation in education and research in numerical methods. Currently, 33 CIMNE Labs operate across nine countries in Latin America and Spain, fostering international collaboration.

First CERCAREMA feminist mentoring workshop held at CIMNE

CIMNE hosted, in December 2025, the first thematic workshop of CERCAREMA, the feminist mentoring programme promoted by the CERCA Institution of Catalan Research Centres to help transform research environments across Catalonia's research institutions.

The session, entitled "Lideratge sense violències" ("Leadership without violence"), was led by Núria Alcaraz Coca, Head of Gender and Language at I-CERCA, and brought together women and non-binary professionals from the CERCA community, including researchers, technical staff, managers and administrators.

The workshop explored the "pyramid of imbalance" in scientific careers, from the sticky floor to the glass ceiling, and examined the different forms of sexist and gender-based violence that can occur in academic and research settings.

Participants discussed protocols for prevention, detection, and response, as well as institutional good practices for promoting safe and respectful workplaces. The session also provided a space for sharing strategies to overcome structural barriers and for building support networks that foster feminist leadership and collective empowerment. CERCAREMA, launched by the CERCA Institution in 2025, combines feminist mentoring, training activities, and experiential workshops aimed at preventing sexual harassment and harassment on the grounds of sex in research centres. The programme targets women and non-binary people from all professional profiles in the CERCA system, reinforcing a community network that prioritises sorority, shared leadership, and mutual support in traditionally masculinised fields.

Part of CIMNE's Equality Plan

CIMNE's involvement in CERCAREMA aligns with the centre's Equality Plan 2022–2026, which includes specific measures on preventing sexual and gender-based harassment, promoting inclusive communication and strengthening the presence of women in scientific careers and leadership roles.

The centre has developed a protocol for the prevention and response to sexual and gender-based harassment, together with training and awareness-raising actions for staff and designated contact persons. As Managing Director Anna Font noted, this type of initiative "helps research centres to move toward work environments where equality, respect, and the diversity of talent become structural elements of scientific excellence".

Scientific and Tech Transfer News

CIMNE's BEE Group Unveils Climate Vulnerability Map for Barcelona

BEE Group successfully finished the Climate Ready BCN project by determining and making accessible the Climate Vulnerability Map for Barcelona. This pioneering initiative allows the evaluation of the effect of extreme weather events and provides user-friendly tools capable of assessing several urban and building retrofitting actions addressed to enhance urban climate resilience.

The map integrates open data, artificial intelligence, and simulation models to assess the impact of heat waves at the building level across Barcelona. At the core of the project is the BIGG Ontology, an open-source repository developed by BEE Group, that standardises and organises Barcelona's data, enabling coherent measurement and analysis of energy consumption, cadastral data, and green zones.

This novel tool evaluates the 70,000 residential buildings in the city, utilising a hybrid approach that combines AI with real-world data. The map provides a detailed diagnosis of climate-vulnerable zones and adverse heat effects, serving as a crucial tool for Barcelona's municipal administration. It will be used as evidence to identify areas and groups most vulnerable to extreme weather events, guiding the allocation of resources such as climate shelters, water fountains, or green zones.

While focused on Barcelona, the methodology developed is designed to be scalable and replicable in other urban contexts. This approach aligns with broader efforts to enhance urban resilience to climate change through data-driven strategic decision-making, one of CIMNE's research priorities.

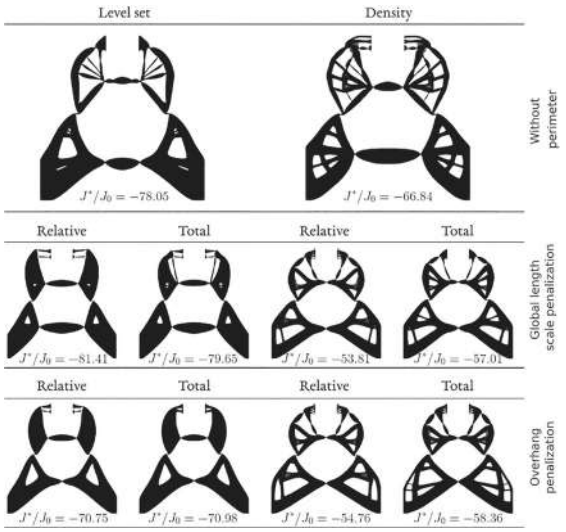
CIMNE Researchers Advance Manufacturable Topology Optimisation

CIMNE researchers Jose Antonio Torres Lerma, Dr Fermin Otero and Dr Alex Ferrer, from the Aeronautical, Marine, Automotive and Energy Engineering research cluster, have published a study in the International Journal for Numerical Methods in Engineering that strengthens the link between topology optimisation and practical manufacturability.

Topology optimisation is widely used to obtain highly efficient structural layouts, but unconstrained solutions often generate intricate geometries that are difficult to fabricate and, in practice, end up relying on additive manufacturing. The study tackles this limitation by introducing a numerical strategy that enforces two key additive-manufacturing requirements at a global level: a minimum length scale (to avoid overly fine features) and overhang control (to reduce unsupported regions during fabrication).

The proposed approach is based on perimeter minimisation, using a regularised version of the perimeter as a penalty term. An isotropic formulation is employed to control global feature length, while an anisotropic formulation targets overhang behaviour, guiding boundary orientation towards more manufacturable configurations. Importantly, the authors show that the method can be integrated with both major families of topology optimisation techniques: density-based methods and level-set approaches.

Across a set of numerical examples—including compliant mechanisms and material-design problems—the strategy reduces the complexity of the resulting shapes by eliminating extraneous bars and simplifying structural layouts. At the same time, it promotes boundary orientations that improve manufacturability, offering a systematic way to obtain cleaner designs without sacrificing the efficiency benefits of topology optimisation.



SMART Ankara Project Delivers Sustainable Mobility Plan for Turkey's Capital

In 2025, the SMART Ankara project reached completion, delivering a comprehensive Sustainable Urban Mobility Plan (SUMP) for the Turkish capital with support from the European Union's IPA programme. The initiative, led by DAI Europe and involving an international consortium, aimed to align Ankara's transport planning with EU sustainability standards and reduce its historical dependence on private vehicles.

CENIT, CIMNE's Innovation Unit in Transport, contributed to the project by developing an advanced activity-based transport simulation model. The tool supports the evaluation of mobility policies by analysing daily travel behaviour, forecasting demand across different transport modes, and assessing the impact of measures such as pricing strategies, shared mobility, and public transport improvements. The project combined extensive data collection, including large-scale household surveys and traffic counts, with digital solutions and capacity-building activities for local authorities. CENIT also delivered specialised training sessions and workshops to strengthen technical expertise within Ankara's transport agencies.

Beyond the mobility plan itself, the initiative supported the design of a smart bike-sharing system and promoted sustainable travel practices among citizens. With its completion, SMART Ankara provides a strategic framework and analytical tools to guide the city's transition towards a more accessible, efficient, and environmentally sustainable transport system.

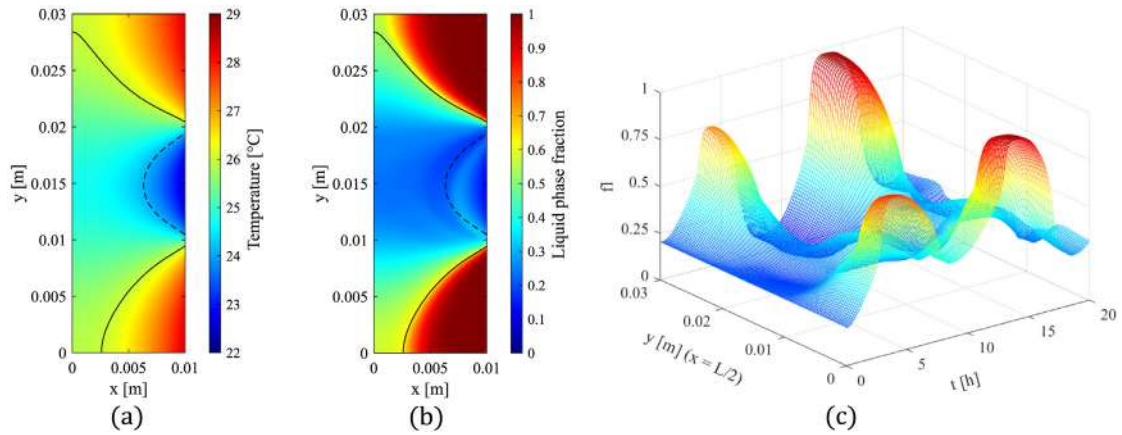
New Computational Method Improves PCM Thermal Storage Modelling

CIMNE has contributed to a new numerical method that improves the simulation of phase change materials (PCMs), supporting more reliable design and optimisation of thermal energy storage systems for buildings, renewable energy applications and industry. By handling the strong non-linearities linked to latent heat and enthalpy hysteresis, the approach delivers more accurate and stable predictions of PCM behaviour during heating and cooling.

The work introduces a finite element method based on a mixed enthalpy–temperature formulation, incorporating a regularised Static Hysteresis Model to ensure smooth phase transitions while retaining energy-consistent behaviour. This formulation enables derivative-based Newton–Raphson iterations, achieving second-order convergence and maintaining numerical stability even with comparatively large time steps.

Validation includes one-dimensional benchmark tests and two-dimensional extensions, demonstrating robustness across different thermal boundary conditions and for both complete and partial phase changes. Compared with conventional apparent/effective specific heat techniques, the method reduces instability and can lower computational cost.

The study is co-authored by CIMNE's Dr Juan Carlos Álvarez Hostos, from *Credible High Fidelity* and *Data Driven Models* research cluster, and an international team, and is published in *International Communications in Heat and Mass Transfer*.



ResilMob Beta System Enhances Infrastructure Resilience and Mobility

The ResilMob project, launched in 2023 with funding from ACCIÓ, is delivering its first results through a beta monitoring system installed on the slopes of Montjuïc, overlooking Barcelona's Ronda Litoral. The 24-month initiative brings together CIMNE and industrial partners to improve the resilience of geostructures in Catalonia's road network.

Led by Mr. Oscar Fruitós, from CIMNE's *Solid and Fluid Simulation for Industrial Processes* cluster, the project has developed a predictive platform that integrates real-time sensor data, numerical simulations, and hybrid artificial intelligence. The system generates status reports, risk alerts, and maintenance forecasts, enabling infrastructure operators to anticipate failures and respond more effectively to extreme weather events.

The prototype combines historical incident records, in-situ measurements, and synthetic data from finite element and particle-based simulations to assess the behaviour of slopes and embankments under adverse conditions. This predictive approach aims to reduce disruptions to road and rail mobility while supporting more efficient maintenance planning.

With a total budget of just over €300,000, ResilMob provides a practical solution for safeguarding critical linear infrastructure. Following the initial development phase, the system is expected to move towards real-world deployment and potential scaling to other regions facing climate-related infrastructure challenges.

ResilMob has been possible with a grant from ACCIÓ, the Catalan Agency for Business Competitiveness, under the Nuclis R+D Empresarial 2022 call.

Juan Martin Cermeño/Wikimedia Commons"

CIMNE Strengthens Safety Modelling for Deep Geological Nuclear-Waste Repositories

CIMNE is contributing advanced computational modelling to DECOVALEX, a long-running international collaboration focused on the long-term safety of deep geological repositories for high- and intermediate-level radioactive waste. Supported by Spanish and French waste-management agencies, ENRESA and ANDRA, the initiative translates complex thermo–hydro–mechanical (THM) and geochemical processes into validated numerical models that inform repository design, monitoring and risk management.

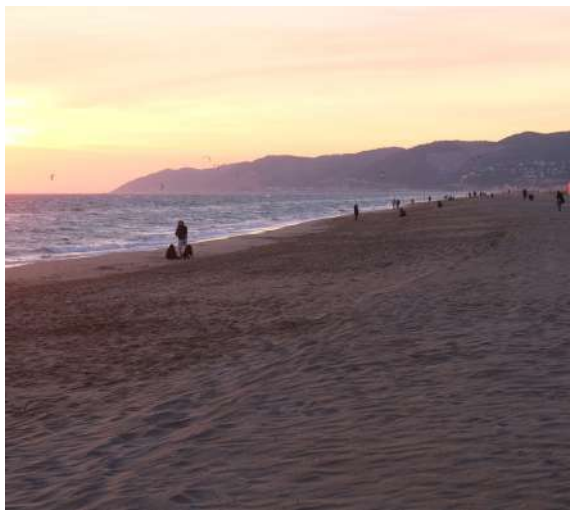
In recent DECOVALEX activities, CIMNE's simulations evaluate how heat released by high-level waste can increase pore pressure and weaken rock around excavations, and how design parameters—such as the spacing of disposal micro-tunnels—affect stress concentrations and damaged zones. The project also studies gas generation (e.g., hydrogen from corrosion) and estimates pressure thresholds that may trigger cracking, supporting repository designs that facilitate safe gas migration without compromising integrity.

CIMNE's *Geomechanics* and *Hydrogeology* research cluster remains involved in the current DECOVALEX-27 edition (2024–2027), building on more than two decades of participation in the programme. The team's work strengthens the predictive capability of coupled-process models and helps reduce uncertainty in long-term safety assessments, supporting evidence-based design choices, monitoring strategies and regulatory decision-making for radioactive-waste management programmes.

AI-Based System Aims to Prevent Drownings at Beaches and Pools

CIMNE has partnered with the Catalan company Pro-activa Serveis Aquàtics to develop an artificial vision system designed to help prevent drownings in aquatic environments. Supported by ACCIÓ under its business R&D programme, the initiative is being tested in a pilot installation at Castelldefels Beach, near Barcelona, with further trials planned in urban swimming pools.

Developed within the LAIF project, the technology uses computer vision and artificial intelligence to analyse activity in real time and detect behaviours associated with drowning risk. When a potentially dangerous situation is identified, the system automatically sends an alert to a control centre, enabling lifeguards and rescue teams to intervene more quickly.



The solution is intended to complement, rather than replace, human supervision. It also explores the deployment of autonomous, renewable-energy monitoring units to provide coverage in areas without permanent lifeguard presence, offering year-round surveillance and more efficient use of public safety resources.

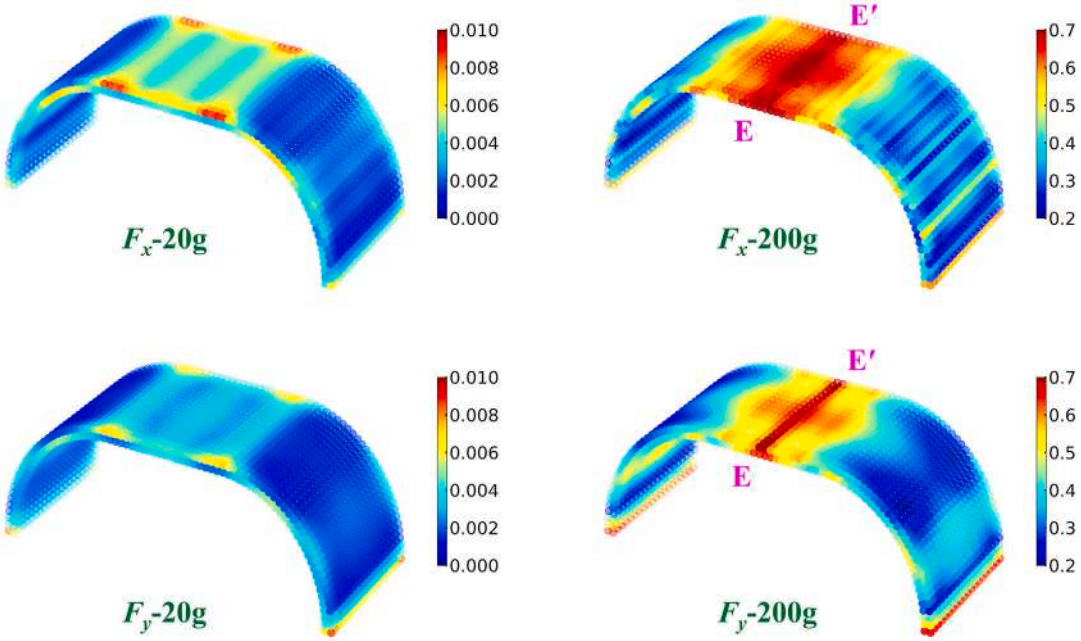
The project demonstrates the role of applied research in strengthening essential public services. With CIMNE's DIGIT innovation unit providing the technological backbone, the LAIF pilot highlights how collaboration between research centres and industry can deliver practical, scalable solutions to societal challenges.

Numerical Method Improves the Reliability of 3D-Printed Concrete

CIMNE's Solid and Fluid Simulation for Industrial Processes cluster has contributed to a study proposing a numerical method to simulate 3D-printed concrete structures and the interfaces between printed layers. The approach helps predict structural behaviour, identify potential discontinuities, and reduce fracture risk—improving overall reliability as 3D printing scales up in construction.

Using a peridynamics-based model validated against experimental results, the researchers analyse the anisotropic mechanical behaviour that can emerge from layer-by-layer deposition, particularly when time gaps create weaker interlayer bonds. The simulations show that printing direction is a key design variable: for a given structure and material, an optimal orientation can maximise long-term safety and load-bearing capacity.

The method is demonstrated on a case study of a 3D-printed concrete bridge, where the model captures how anisotropy influences damage and cracking under different loading conditions. The findings support practical mitigation strategies, including reducing the time between layers and selecting the most favourable printing direction for each application.



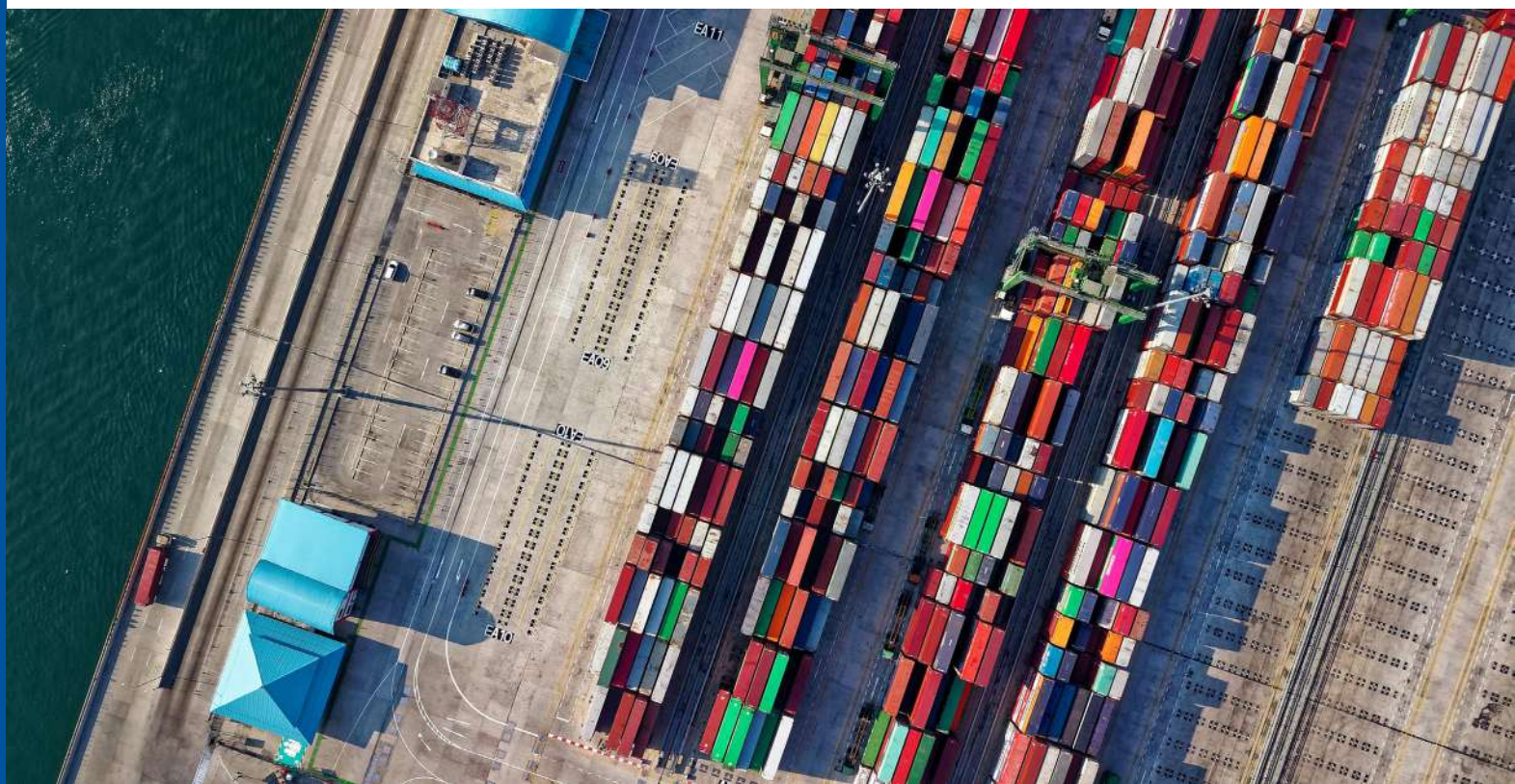
CIMNE Project Monitors Impact of EU Emissions Trading System on Spanish Ports

Researchers at CIMNE's Innovation Unit in Transport, CENIT, are working on a new project to assess the impact of the EU Emissions Trading System (EU ETS) on Spanish ports. The initiative, titled *Observatory of the Impact of the ETS on Spanish Ports*, is led by the Spanish Port Authority (Puertos del Estado) and runs for three years from April 2025, with participation from Shipping Business Consultants and NextPort.

The project examines how the extension of the EU ETS to maritime transport is reshaping shipping decisions and affecting port competitiveness. Since January 2024, vessels calling at EU ports have been subject to carbon costs based on their emissions, raising concerns that some operators may reroute traffic to avoid these charges.

To address this challenge, the observatory is developing a real-time monitoring system based on AIS data, combined with other maritime information sources. The platform integrates econometric models and machine learning techniques to detect changes in traffic patterns, simulate regulatory scenarios, and identify potential risks and opportunities for different ports.

The project will deliver interactive dashboards and analytical tools to support port authorities, policymakers, and logistics operators in strategic decision-making. By providing early insights into market shifts, the initiative aims to help Spanish ports remain competitive and aligned with Europe's decarbonisation objectives.

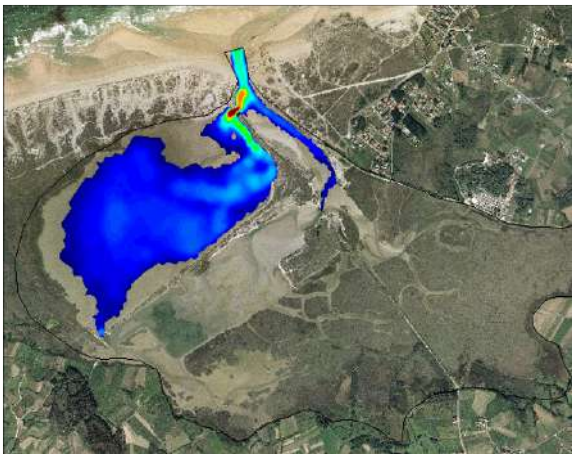


CIMNE's GiD Enhances Iber River-Flow Modelling

Iber is a two-dimensional numerical model for simulating free-surface flows in rivers and estuaries. It solves the depth-averaged shallow water equations to compute water depth and the two horizontal components of depth-averaged velocity, using an explicit unstructured finite-volume solver. The model has been extensively validated and applied in studies of river inundation and tidal currents in estuarine environments.

CIMNE's DIGIT Innovation Unit has been involved in the Iber project from the outset, contributing the GiD pre- and post-processing platform to integrate the different software tools and streamline the workflow for end users. This includes the development of specific GiD features to support efficient model setup, execution and interpretation of results within GIS-compatible environments.

A key contribution is the automation of terrain-data handling: GiD has been adapted to read and process cartographic datasets in multiple formats, making terrain preparation largely transparent for users. DIGIT has also developed functionalities to automate mesh generation from imported terrain models, and has tailored post-processing tools to the pseudo-2D nature of Iber hydrodynamic simulations, improving visualisation and analysis of model outputs.



Virtual Worlds Framework Advances Human-Centric Digitalisation in AECO

CIMNE researchers are advancing a methodological framework to help the Architecture, Engineering, Construction and Operation (AECO) sector build immersive "Virtual Worlds" that enable richer collaboration, more intuitive interaction with data, and more human-centric digital workflows aligned with Construction 5.0.

The work targets a persistent limitation in current AECO digital practice: despite the progress enabled by Building Information Modelling (BIM) and Digital Twins, many workflows remain fragmented and are not designed for interactive, multi-user environments that support coordinated decision-making across distributed teams.

Developed within CIMNE's Structural and Particle Mechanics research cluster, the proposal organises Virtual Worlds capabilities into a four-layer architecture: Data & Context to structure and contextualise information; Processing & Simulation to run models and analytics; Interaction & Visualisation to deliver immersive, user-centred interfaces; and Integration & Connectivity to ensure interoperability across platforms and stakeholders.

The framework combines enabling technologies—including Extended Reality (XR), Artificial Intelligence (AI) and gaming engines—with established AECO assets such as BIM and Digital Twins, supporting avatar-driven participation and shared situational awareness while improving engagement with complex project information.

To demonstrate practical relevance, the study outlines five conceptual prototypes spanning applications such as experiential training, design validation and remote inspection. These examples illustrate how Virtual Worlds could complement existing tools by improving coordination, supporting safer and more efficient field activities, and widening access for diverse stakeholder groups—providing a roadmap for scalable adoption in AECO operations.

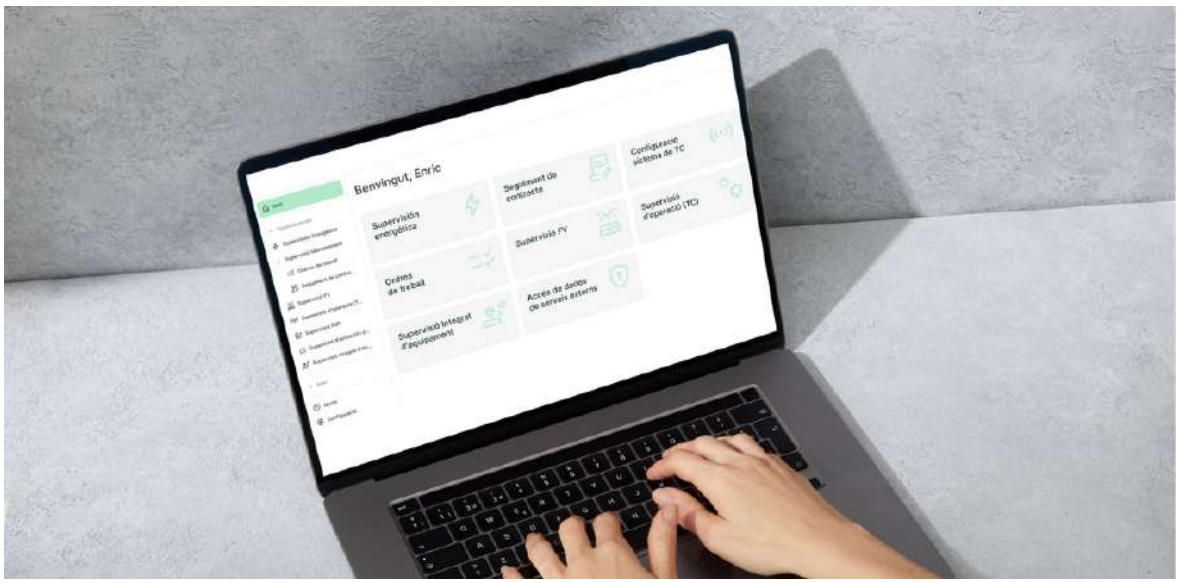
MindOpera Powers Smarter Energy and Maintenance Management Across Catalonia's Public Buildings

CIMNE's BEE Group has renewed its service contracts with the public companies Infraestructures.cat and the Catalan Energy Institute (ICAEN) to continue providing MindOpera, an AI-powered reference platform for the integrated management of the Government of Catalonia's public building portfolio. The renewals reinforce BEE Group's data processing and analytics capabilities while supporting energy efficiency programmes and energy sovereignty across more than 11,000 public buildings.

Developed by CIMNE, MindOpera enables public administrations and large facility operators to unify, analyse and optimise energy and maintenance data in a single environment. It acts as the core engine behind Infraestructures.cat's Data Orchestrator (l'Orquestrador) and ICAEN's Energy Monitoring System (SIME), integrating heterogeneous sources such as BMS/SCADA systems, IoT devices, work orders and metering data through semantic harmonisation and automated orchestration.

The platform currently connects over 11,000 public facilities, with around 2,000 fully digitalised, covering tens of thousands of zones and devices. By automating data collection, indicator generation and intelligent alerts, MindOpera supports anomaly detection, predictive maintenance and consumption reduction strategies, enabling earlier intervention, lower CO_2 emissions and improved optimisation of self-generated energy.

Built on a modular cloud architecture, MindOpera combines real-time ingestion and scalable data services with AI modules for operational benchmarking and performance monitoring. The project consolidates a digital governance approach for the public sector, providing a scalable foundation for more efficient, resilient and decarbonised building operations.

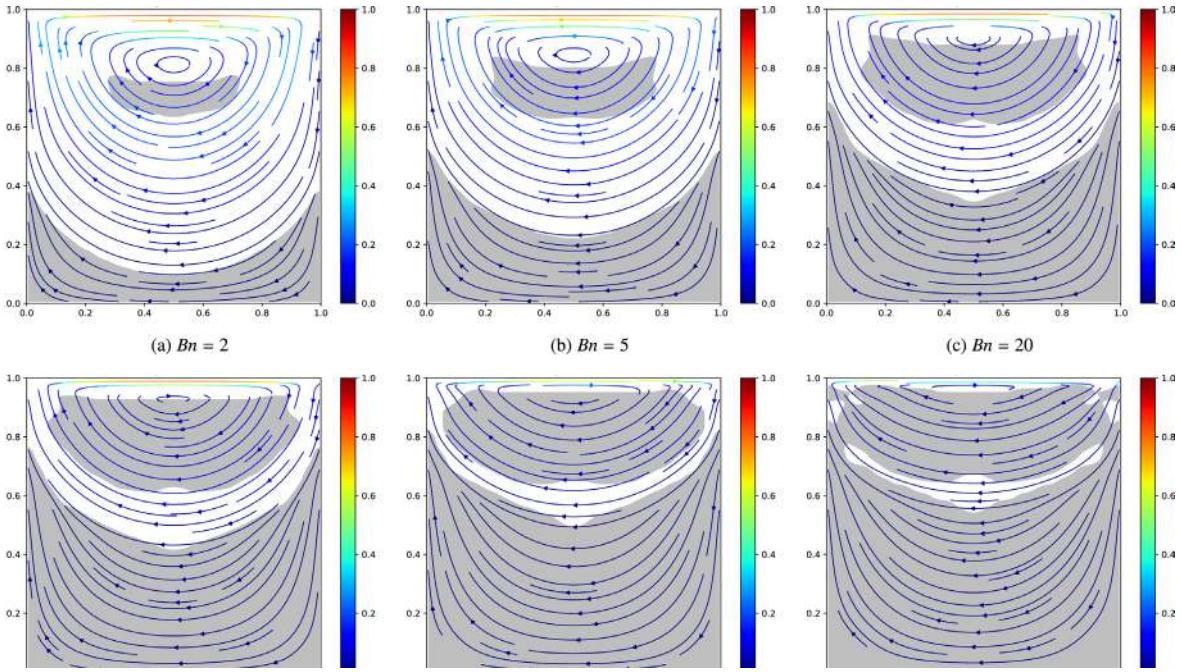


CIMNE Advances Isogeometric Analysis for Viscoplastic Fluid Flows

Researchers from CIMNE's *Large Scale Multiphysics Computations* research cluster have contributed to a new study that expands the use of Isogeometric Analysis (IGA) for the simulation of non-Newtonian viscoplastic fluids. The work addresses a key challenge in computational fluid dynamics: accurately representing flows with yield surfaces and other non-smooth features, where sharp transitions and localised singularities can reduce the effectiveness of high-continuity numerical approaches.

The study develops a stabilised isogeometric framework for viscoplastic Stokes flow based on the Variational Multiscale (VMS) method. This formulation improves numerical stability and avoids spurious pressure oscillations when using equal-order discretisations. In parallel, the researchers incorporate an embedded boundary strategy based on the Shifted Boundary Method (SBM), allowing complex geometries to be handled efficiently without relying on body-fitted meshes.

Published in *Computer Methods in Applied Mechanics and Engineering*, the paper provides a practical framework for simulating non-Newtonian viscoplastic flows with greater accuracy and flexibility. Beyond the specific application, the findings offer useful guidance on the role of basis smoothness, stabilisation strategies and embedded boundary techniques in the numerical treatment of complex fluids.



(a) $Bn = 2$ (b) $Bn = 5$ (c) $Bn = 20$

Publications

In 2025, CIMNE research clusters and innovation units produced **193 publications** in areas ranging from computational mechanics and multi-physics simulation to **advanced materials** and sustainable engineering. About **70%** appeared in **Q1 journals** and **66%** were available under **open access**.

Selected publications

Computational ElectroHydroDynamics in microsystems: A Review of Challenges and Applications
Narváez-Muñoz C., Hashemi A.R. , Hashemi M.R., Ryzhakov P.B., Segura L.J.
DOI: 10.1007/s11831-024-10147-x

2D Vermiculite Nanolaminated Membranes for Efficient Organic Solvent Nanofiltration
Wang W., Petit E., Moderne M., Li J., Liu J., Wu H., Qi K., Miele P., Salameh C., Voiry D., Hao X., Yan Y., Sun R., Lajaunie L., Zamora-Ledezma C., Narváez-Muñoz C., Hassani C.B., Zeng Z.
DOI: 10.1002/adfm.202410635

Large-scale horizontal axis wind turbine aerodynamic efficiency optimization using active flow control and synthetic jets
Nabhani A., Tousi N.M., Bergadà J.M., Coma M., Bugeda G.
DOI: 10.1016/j.energy.2025.134940

Computation of leaky waves in layered structures coupled to unbounded media by exploiting multiparameter eigenvalue problems
Gravenkamp H., Plestenjak B., Kiefer D.A., Jarlebring E.
DOI: 10.1016/j.jsv.2024.118716

Time-dependent tunnel deformations: Insights from in-situ tests and numerical analyses
Zhang S., Rodriguez-Dono A., Song F., Zhou Z.
DOI: 10.1016/j.tust.2024.106319

An enhanced total Lagrangian SPH for non-linear and finite strain elastic structural dynamics
Gotoh T., Sakoda D., Khayyer A., Gotoh H., Lee C.H., Gil A., Bonet J.
DOI: 10.1007/s00466-024-02592-z

Analysis of short- and long-term coupled THM behaviours in argillaceous rock for nuclear waste disposal
Song F., Wang H., Gens A., Collico S., Plúa C., Armand G.
DOI: 10.1016/j.gete.2025.100660

Investigation on the scale-dependent behavior of microstructure characteristics of laser powder bed fused TiB2/AlSi10Mg composite
Feng Z., Wang Y., Dang M., Tan H., Hao Z., Zhang S., Chen Y., Peng Y., Zhang T., Shi S., Lin X., Huang W., Wang G., Fan W., Lu X., Zhang F.
DOI: 10.1016/j.jmst.2024.06.004

Fatigue delamination damage analysis in composite materials through a rule of mixtures approach
Taherzadeh-Fard A., Jiménez S., Cornejo A., Oñate E., Barbu L.G.
DOI: 10.1016/j.compstruct.2024.118613

Flood-related hazard criteria during the human evacuation of underground spaces through stairs: a state-of-the-art review
Aparicio Uribe C.H., Russo B., Téllez-Álvarez J., Martínez-Gomariz E.
DOI: 10.1007/s11069-024-07002-4

A multiscale Pseudo-DNS approach for solving turbulent boundary-layer problems
Gimenez J.M., Idelsohn S.R., Montaño S.I., Aguerre H.J., Nigro N.M., Sívori F.M., Larreteguy A.E.
DOI: 10.1016/j.cma.2025.117804

Numerical investigation of THM behavior in anisotropic poroelastic media: from element test to geological disposal applications
Song F., Wang H., Gens A., Collico S.
DOI: 10.1016/j.gete.2025.100653

PhD Theses

28 PhD students successfully defended their dissertation at CIMNE in 2025. We welcomed new doctors across the board, with research topics ranging from fluid flow study in Geomaterials to Transport Planning for Autonomous Vehicles.

Theses defended in 2025

Reduced order models and machine learning techniques for digital twin applications
Ares de Parga, Sebastián
Advisors: Rossi, R.; Alberto, J.

Soil Deterioration and Crack Formation during Drying. Mitigation Strategies
Encalada, David Alejandro
Advisors: Ledesma, A.; Prat, P.

Mathematical and computational modeling of the active mechanics of multicellular systems: from cell-cell adhesion to epithelial reshaping
Bal, Pradeep Kumar
Advisor: Arroyo, M.

Efficient coupling of local parametric surrogate models via domain decomposition
Evans, Ben J.
Advisors: Discacciati, M.; Giacomini, M.

Dynamic measurements in control systems
Baraharska, Miroslava
Advisors: Slavov, T.; Markovsky, I.

Numerical techniques for the solution of thermal problems in the context of geophysical inversions
Fernández, Mariano
Advisors: Zlotnik, S.; Díez, P.

Numerical tools for the assessment of offshore wind platforms
Berdugo, Irene
Advisors: García, J.; Serván, B.

Data-Driven Patient-Specific Models Supporting Decision Making with Application to Atherosclerotic Plaque Analysis
Gahima, Stephan
Advisors: Díez, P.; García, A.

Process-Based Numerical Models to Assess Hydrogeochemical Effects of Microbial Biofilms in Porous Media.
Dawi, Malik
Advisors: Sánchez-Vila, X.; Starnoni, M.

Evaluación de la resistencia residual. Efecto de la velocidad de corte, temperatura e interacción termo-hidro-mecánica (THM)
García, Luís Miguel
Advisors: Lloret, A.; Pinyol, N. M.

Continuum and computational modelling of surface effects in flexoelectric materials
Dingle, Monica
Advisors: Arias, I.; Codony, D.

Impact of mixing-driven precipitation and sharp soil interfaces on solute transport: from laboratory visualization to numerical modeling
González, Reinaldo Guido Moisés
Advisor: Fernandez, D.

Integration of Spatial and Temporal Patterns for ecological environment management in River-Riparian System
Duolan
Advisors: Bladé, E.; Sànchez, M.

Designing Robust Transport Policy Mechanisms for Multiple Economic and Institutional Settings under Uncertainty
Majoral, Genís
Advisor: Saurí, S.

IGA application on crashworthiness CAE analysis including advanced plasticity and ductile fracture
Martorell, Lluís
Advisors: Rossi, R.; Barbú, L.

Advancing Decision Support: Content Management, Ecommerce, and the Challenge of Interoperability for Integrated Modeling
Sigler, Laurence
Advisors: Ubach, P. A.; Mora, J.

Modelling Hydro-Mechanical Coupled Gas Injection in Low Permeability Clay Materials
Mo, Yangyang
Advisors: Olivella, S.; Rodríguez, A.

On the study of delamination and failure of composite materials under static and cyclic loads
Taherzadeh, Alireza
Advisors: Barbu, L.; Oñate, E.

Coupled modelling and sustainability assessment of polymeric reinforced soil retaining structures subjected to environmental conditions
Moncada, Aníbal
Advisors: Puig, I.: Olivella, S.

A multitemporal and multiscale analysis of soil erosion and sediment transport. Application to the badlands in the Upper Llobregat River Basin
Torra i Truncal, Ona
Advisors: Hürlimann, M.; Puig, C.

Towards shock absorbing hyperelastic metamaterial design
Núñez, Alejandro
Advisors: Oliver, F. J.; Cante, J. C.

Advanced Finite Element Methods for Metal Forming and Manufacturing Process Simulation: An Application to Friction Stir Welding Analysis
Venghaus, Henning
Advisors: Chiumenti, M.; Baiges, J.; Juhre, D.

Data assimilation for real-time dynamic prediction of wind-induced forces in vehicle platooning
Perelló, Rafel
Advisors: Huerta, A.; Zlotnik, S.

Thermo-hydro-mechanical-chemical impacts of high-temperature aquifer thermal energy storage
Vidal, Rubén
Advisors: Olivella, S.; Saaltink, M. W.

Comportamiento hidráulico de aliviaderos de perfil estricto en zonas de gran altitud
Rendon, Víctor Óscar
Advisor: Sànchez, M.

Hydromechanical Simulation of Argillaceous Rocks for Radioactive Waste Disposal Applications
Yazadani, Davood
Advisors: Vaunat, J.; Gens, A.

Enhanced Inherent Strain Modelling for Powder-Based Metal Additive Manufacturing
Setien, Iñaki
Advisor: Chiumenti, M.; San Sebastián, M.

Study on rock fragmentation mechanism and ball loading parameter matching in ball mill
Zhang, Sheng
Advisor: Rodríguez, A.

CIMNE Labs

The **CIMNE Labs Network** (*Red de Aulas CIMNE*) is a matrix of international cutting-edge research labs associated with CIMNE, leveraging cooperation in education and research and technological development (RTD) in the field of numerical methods in engineering. Each lab is created through a collaboration agreement between CIMNE and a hosting institution, and are locally managed by esteemed professors in fields ranging from materials science to structural mechanics.

There are currently 33 CIMNE Labs in 10 countries.

5 Argentina	5 Spain	6 Mexico	5 Colombia	4 Brazil
3 Chile	1 Peru	2 Cuba	1 El Salvador	1 Guatemala

The International Network of CIMNE Labs

The International Network of CIMNE Labs is a non-governmental, non-profit organization bringing together CIMNE Labs around the globe. The network promotes continuous education, interdisciplinary collaboration, and exchange programs for researchers and students. It also supports the development of emerging knowledge areas, enhancing global expertise and positioning itself as a reference in numerical methods for engineering. Since 2021, it has organised the annual International Symposium Aulas CIMNE, where the Labs present their latest contributions to the international research community.

Red Aulas CIMNE

Minor changes from last year

Although the activity of **CIMNE Labs** is currently split between Spain and Latin America, the centre is committed to replicating this collaboration formula through Europe, expanding innovation opportunities with top research institutions across the continent. This strategy, called out in CIMNE's Strategic Plan, will strengthen innovation and training efforts with institutions with which CIMNE already has close ties, like the Swansea University (Wales), the University of Pavia (Italy), TU Braunschweing (Germany), or the Technical University of Athens (Greece).

CIMNE Congress Bureau

The CIMNE Congress Bureau is a globally-recognized entity specializing in the management of highly-specialized conferences, events, and associations. With decades of expertise, it provides tailored solutions for technical and administrative needs, ensuring seamless event execution. Trusted by leading global organizations in numerical methods and computational engineering, it combines personalized service with innovative tools to deliver proven results at a reasonable cost.

Top Conferences 2025

DTE 2025

3rd IACM Digital Twins in Engineering Conference (DTE 2025) & 1st ECCOMAS Artificial Intelligence and Computational Methods in Applied Science (AICOMAS 2025)

17-21 February | *Paris, France*

COUPLED PROBLEMS 2025

XI International Conference on Coupled Problems in Science and Engineering

25-28 May | *Villasimius, Italy*

COMPLAS 2025

XVIII International Conference on Computational Plasticity

2-5 September | *Barcelona, Spain*

PARTICLES 2025

IX International Conference on Particle-based Methods

20-22 October | *Barcelona, Spain*

2025 in Numbers

29	6,167	5,750
conferences	attendees	contributions

Some of Our Partners

The CIMNE Congress Bureau has a long-standing collaboration with some of the world's leading institutions in the field of numerical methods and computational engineering, including:

The European Community on Computational Methods in Applied Sciences

The International Association for Computational Mechanics

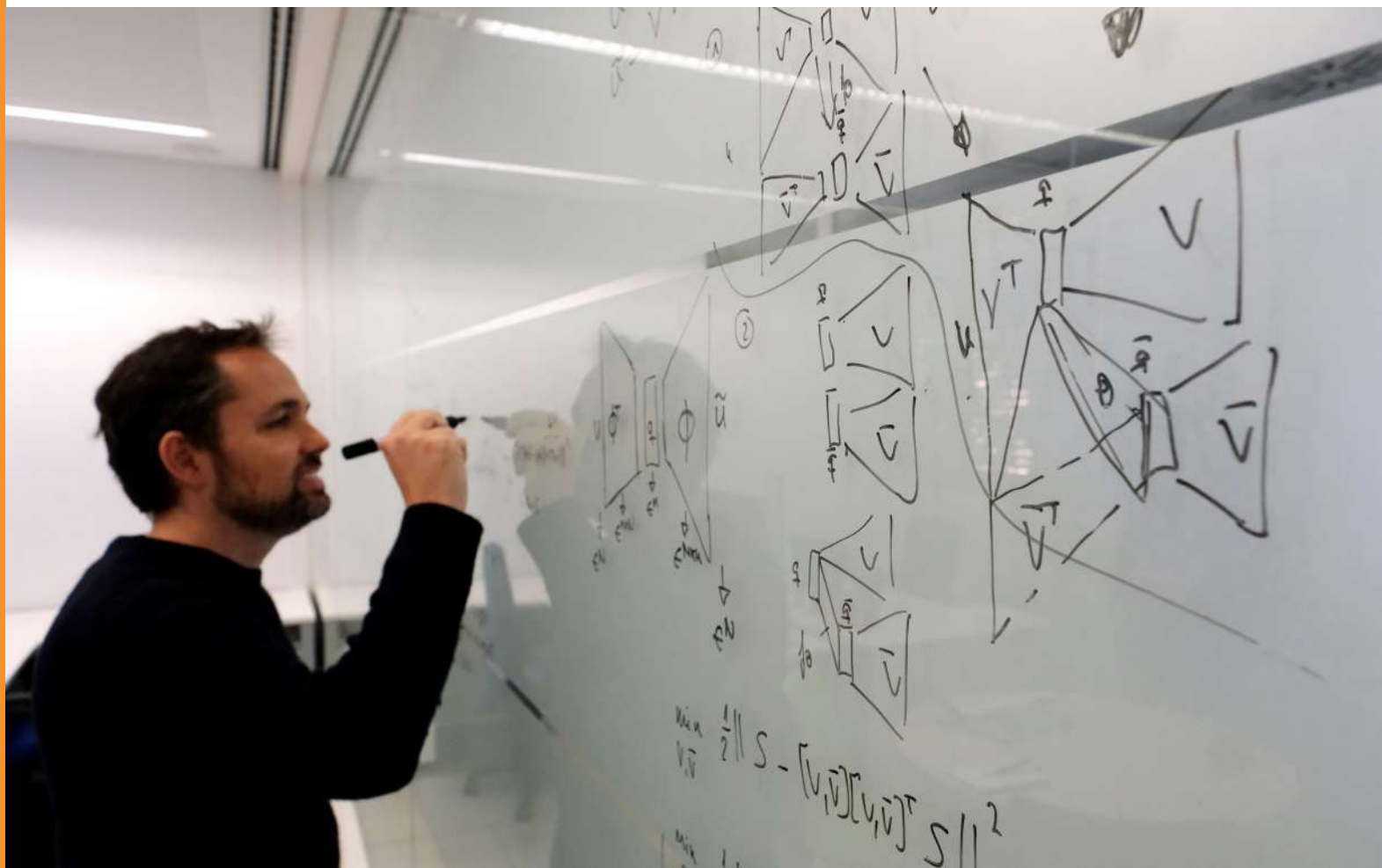
Spanish Society of Computational Mechanics and Engineering

Italian Society of Applied and Industrial Mathematics

Management of Scientific Associations

Fostering Global Engineering Excellence

CIMNE's Congress Bureau has established itself as a global leader in the management of scientific associations in the fields of numerical methods and computational engineering. With decades of experience and a deep understanding of the academic landscape, CIMNE has developed unparalleled expertise in organizing high-level scientific conferences, managing complex international networks, and facilitating knowledge exchange among researchers worldwide. Currently, CIMNE holds the permanent secretariat for several prestigious scientific societies, a testament to its ability to provide comprehensive administrative support, strategic guidance, and innovative solutions for the global scientific and engineering community. This unique position allows CIMNE to foster collaboration, drive scientific progress, and maintain its status as a key player in the advancement of computational engineering and related disciplines.



Scientific Associations Managed by CIMNE

European Community on Computational Methods in Applied Sciences (ECCOMAS)

ECCOMAS is a leading scientific organization in numerical methods, founded in 1993. It groups different European associations with interests in the development and applications of computational methods in science and technology, promoting world-leading events in the field. CIMNE has led the secretariat of ECCOMAS since its founding.

Spanish Society of Numerical Methods in Engineering (SEMNI)

SEMNI emerged in 1989 with the aim of bringing together researchers, professionals, companies, and institutions interested in the development and practical applications of numerical methods. The society organises periodic conferences and events, and promotes awards recognizing young talent. CIMNE has led the secretariat of SEMNI since its inception.

International Association for Computational Mechanics (IACM)

IACM is a global organization advancing computational mechanics, fostering collaboration and innovation. Strongly linked to CIMNE since its 1981 inception, CIMNE held IACM's permanent secretariat from 1994 to 2016, reflecting their shared commitment to the field's growth and excellence.

International Association for Shell and Spatial Structures (IASS)

IASS is a non-profit organization whose goal is to promote progress through an interchange of ideas among all those interested in lightweight structural systems, including architects, engineers, builders and academics. CIMNE leads its secretariat, supporting IASS's activities and strengthening its international network.

International Association of CIMNE Labs (AIAC)

CIMNE manages the secretariat of AIAC, promoting spaces for scientific exchange and bringing together top researchers from more than 10 countries and over 30 institutions. The secretariat ensures AIAC can fulfil its goals of research, education, innovation, and dissemination.

Awards

The **12 awards** received by CIMNE experts and projects with the centre's participation in 2025 testify to the scientific talent of our community and the commitment of CIMNE to innovating to the benefit of society.

Awards to People

Arroyo, Marino
2025 Academia Excellence programme
Catalan Ministry of Research and Universities

Chiumenti, Michele
2025 Academia Excellence programme
Catalan Ministry of Research and Universities

Ortiz, Michael
2025 Jerald L. Ericksen Prize
Society for Industrial and Applied Mathematics (SIAM)

Rodríguez Dono, Alfonso
2025 EUCEET Award for Excellence in Teaching in Civil Engineering
European Civil Engineering Education and Training Association (EUCEET)

Soudah, Eduardo
Honourable Mention Award at IWEM 2025
IEEE International Workshop on Electromagnetics Applications and Student Innovation Competition

Sellart, Maria Teresa
Best paper by a young researcher
IEEE MetroLivEnv 2025

Bisighini, Beatrice
PhD Thesis Prize
Société de Biomécanique

Alonso, Matías
Giovanni Barla Best Paper
Rock Mechanics and Rock Engineering

Appointment

Oñate, Eugenio
Member
Real Academia de Ingeniería

Dissemination

Dissemination of science, innovation, and technology transfer is one of the pillars at CIMNE. These efforts not only appeal to existing audiences —from PhD students to Senior Researchers— but seek to engage new publics into the conversation to ensure science and engineering work for everyone.

In 2025, CIMNE reinforced its commitment to disseminating the impact of its efforts by publishing an updated website in English, Catalan and Spanish, organising specialised events such as the public presentation of Barcelona's Energy Vulnerability Map, and voicing expert opinions in local media in light of relevant events.

CIMNE believes in communication as an avenue for transparency and open dialogue with society, as well as an opportunity to advance computational engineering research through collaborative efforts with the global scientific community.

Communication Highlights of 2025

11
Coffee Talks

Casual events to discuss ongoing and exploratory research, best practices, and state-of-the-art reviews related to CIMNE's disciplines.

17
Seminars

Presentations on innovative research and high-impact scientific challenges, especially by external contributors.

+600
Social Media Posts

Across different platforms, highlighting CIMNE's activities, research, and impact on society.

+30
Media Appearances

Impacts from CIMNE in local and specialized media, including interviews with experts and dissemination of research and innovation solutions.

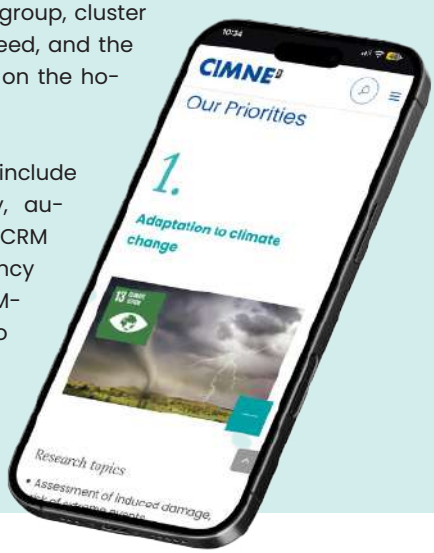
New Website

In 2025 CIMNE launched an all-new website at cimne.com, designed to better communicate our mission and engage global audiences. The site now offers full support for Catalan and Spanish, improving accessibility for local partners, collaborators and the wider community.

Navigation has been simplified and the visual identity has been fully renovated with a coherent palette, typography and layout to deliver a recognisable, consistent look.

The new Research Clusters and Innovation Units are now prominently featured, with a dedicated mini-website for BEE Group, CENIT, and DIGIT. Technology Transfer and Societal Impact receive dedicated sections and impact stories that make outcomes and pathways to application easier to follow. Events, news and updates are simpler to locate: every group, cluster and unit has its own news feed, and the latest items are highlighted on the homepage.

Operational improvements include better mobile compatibility, automation with our internal CRM and a refreshed Transparency section. Attention to the CIMNE Congress Bureau has also been renewed with its own stand-alone website.



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