International Centre for
NUMERICAL METHODS
IN ENGINEERING

ANNUAL REPORT 2022

CIMNE^R

EXCELENCIA
SEVERO
OCHOA

Since 1987

GENERATING KNOWLEDGE AND SOLUTIONS

CENTRE CERCA

Annual Report 2022

CIMNE®

GENERATING KNOWLEDGE AND SOLUTIONS
Since 1987

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CIMNE's spin-off researcher Naeria Navarro at Plocan (COOSW project-Cool Steam Technology –www.freshwaternature.com)

DIRECTOR'S LETTER

Javier Bonet // General Director of CIMNE

The International Centre for Numerical Methods in Engineering (CIMNE) was created in April 1987 and celebrated its 35th anniversary in 2022. The year 2022 also saw the transition from CIMNE´s founding Director and Vice-President Prof. Eugenio Oñate to my appointment in May as the new Director. It is indeed a great honour but also a tremendous challenge to take over the responsibility for the Centre after its illustrious history and trajectory at the hands of Prof. Oñate. I have been overwhelmed by the warm reception and support from staff at CIMNE, which has made my transition as smooth as possible. I am aware that there is indeed a lot to learn and have endeavoured to adapt as quickly as possible to the new environment in the UPC, Catalan and Spanish systems after a long academic career in the UK. However, I am aware that my roots are in this environment and my experiences abroad can be of use in the present role. I also inherit a strong management team who have been part of CIMNE´s leadership for a number of years and a team of academic researchers, engineers and support staff who are the core and driving force behind our success.

One of the first activities undertaken as new director has been the development of a strategic plan for CIMNE for the next decade and beyond. This was discussed with a significant number of staff at CIMNE and external stakeholders during the latter part of 2022 and presented to the Governing body in December. The plan aims to strengthen CIMNE´s international position as the world leading centre in the development of computer modelling technologies applied to important engineering problems that respond to societal challenges and UN sustainable development goals. The strategy to achieve this over the next 5 years comprises four key elements:

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

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

- **Adaptation to Climate Change:** including the assessment of hazards and risk of extreme events; coastal, floods & landslides protection; infrastructure assessment and adaptation; resilient and sustainable land management.

- **Mobility, Cities and Territory:** transport & civil infrastructure; cities & urban mobility; transport systems and logistics; aerospace and vertical mobility; maritime transport; automotive transport.

- **Energy and Environment:** renewable energy; materials for energy; fusion, nuclear, waste treatment; energy storage and conversion technologies; energy efficiency and distribution; water production, storage, treatment and distribution; air, water and land contamination.

- **Industrial processes:** advanced and innovative manufacturing; automation and optimization of industrial processes; emerging materials – metamaterials; smart construction.

- **Health:** modelling bio-systems and bio-materials; patient-specific approaches for detecting and predicting diseases; medical devices; bionic systems; mechanobiology.

cimne.com/mission

The key enabling methodologies are:

• **Discretization techniques:** novel grid and grid-free approaches; particle methods; unfitted methods, error assessment and adaptivity.

• **Physical and mathematical models.** Comprising multiphysics constitutive models and formulations, variational and mathematical principles, optimization techniques and similar technologies.

• **Data driven technologies:** including machine learning and artificial intelligence, reduced order models, big data, uncertainty quantification and digital twins.

• **High performance computational models.** For instance, modelling technologies to exploit emerging computer architectures.

2. Enhancing relationships with our patrons and international partners

Effective relationships with the patrons of CIMNE, namely the UPC and three departments of the Generalitat represented in the governing body are critical to the future success of CIMNE. CIMNE enjoys an international network of collaborators, some formally established through Aulas CIMNE in Spain and Latin America.

CIMNE aims to extend this network by establishing joint research laboratories with European and other international partners. These networks will be exploited to secure project funding through schemes such as MSC-doctoral Networks.

CIMNE will also enhance its leading presence in international learned societies beyond IACM, ECOMASS and others where we currently already play a significant role.

3. Attracting, retaining and developing the best international researchers, innovators and professional support staff

The ability to attract the best staff is key to the success of CIMNE. CIMNE will particularly endeavour to improve its ratio of female to male academic staff, especially in leadership positions. This will require proactive and focused efforts in recruitment and creating a supportive environment of attractive work life balance measures.

4. Ensuring that our research has maximum impact in society

The societal impact will be generated by the establishment of technology transfer pathways, a culture of innovation and facilitating the creation of spin-off companies, when appropriate.

CIMNE will endeavour to demonstrate the societal impact of its research and facilitate the transfer of technology to existing industries or create new ones through spin-offs. For this purpose, CIMNE will:

• **Create an Industrial Advisory Board** comprising of industries and government departments that interact with the research and innovation at CIMNE;

• **Carry out a centre wide Road Mapping Exercise** using the methodology of the Institute for Manufacturing in Cambridge University. This will help us refine our themes of research and map the route between technology developments and future applications.

> ❝ *CIMNE will particularly endeavour to improve its ratio of female to male academic staff, especially in leadership positions*

RESEARCH FOCUS, OUTCOMES AND ACHIEVEMENTS

During 2022 research at CIMNE has focused on the development of NM of interest to the following scientific fields: structural mechanics, geomechanics, fluid dynamics, material sciences, optimization, 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 CIMNE web page

On December 2019 **CIMNE was selected as one of the "Centres for Excellence Severo Ochoa" accredited by the Spanish State Research Agency**, attached to the Spanish Ministry of Science, Innovation and Universities. The Severo Ochoa Centres are selected on the basis of their excellence on scientific research and technical development activities. **This important distinction includes governmental funding to hire some 35 new PhDs and 15 Postdocs for the period 2020-2023.**

During much of 2022 CIMNE was under the auspices of the Department of Vice-presidency, Digital Policies and Territory of the Catalonian Government. This has broadened and strengthened the research activities of CIMNE on civil and environmental engineering sector by incorporating digital technologies with applications to predictive territory management, smart infrastructures, water resources, energy efficiency, digital twins for improved industrial processes, building integration modelling (BIM), transport and mobility and environmental quality and safety. **At the end of 2022 the Catalan Government Department chan-**ged to Department of Territory and Sustainability but the focus on digital technologies has continued.

In 2022 CIMNE researchers published about 170 papers in JCR journals, of which 80% were published in first quartile journals, and have received close to 5000 citations to their work according to Scopus. CIMNE scientists are chief editors or associated editors of 6 JCR journals and members of the editorial board of 15 JCR journals.

In 2022, **CIMNE researchers have taken part in 85 RTD projects funded by international** (33 projects) **and national** (52 projects) **organizations which have meant funding of 3,5 M€** for CIMNE. In the same period CIMNE had 106 RTD contracts with companies and private organizations amounting some 1,6 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 organizations, dissemination activities, revenues from CIMNE spin-off companies and an efficient management structure.

In 2022, the self-obtained income obtained by CIMNE amounted to some 83% of its total annual budget. Details of the sources of CIMNE funding in 2022 and in recent years can be found on page 10.

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

Javier Bonet
General Director of CIMNE

2022 in news

Farewell of Eugenio Oñate to directors of CERCA centres

In March 2022, Professor Eugenio Oñate gave a farewell speech at the meeting of the Institution of Research Centers of Catalonia (CERCA). In his intervention, Prof. Oñate spoke about the contribution of the founding directors of CERCA and the challenges of the next generation of directors now active. He made a positive assessment of his 35 years as a CIMNE director and wished success to the directors of research centers attending the act.

The speech could be read on cimne.com/vnews/2729

Javier Bonet, the new director of CIMNE

Professor Javier Bonet started on May 16th as the new General Director of CIMNE. He joins CIMNE taking over from Professor Eugenio Oñate, CIMNE's founding director and current Vice-president of the Governing Council. "It is a great honour, but also a huge challenge. I hope that I will meet the expectations of the post and that I will be able to steer smoothly this internationally renowned research centre through the change of director phase and into a bright future", states Prof. Bonet.

Read more on cimne.com/vnews/11630

### CIMNE passes the CERCA avaluation with an 'A' qualification

The regular assessment of the activity and operation of a system is essential when drawing up and implementing policies based on strategic planning.

As a CERCA Centre, CIMNE has to undergo periodically an evaluation by this organization, to ensure that achieve the international standards requiered by the network. On 20th October, 2022, CIMNE has passed the CERCA avaluation for the period 2018-2021 with an 'A' qualification.

Further information on cimne.com/vnews/11743

Five new CIMNE research projects in ecological transition funded by the Spanish Government
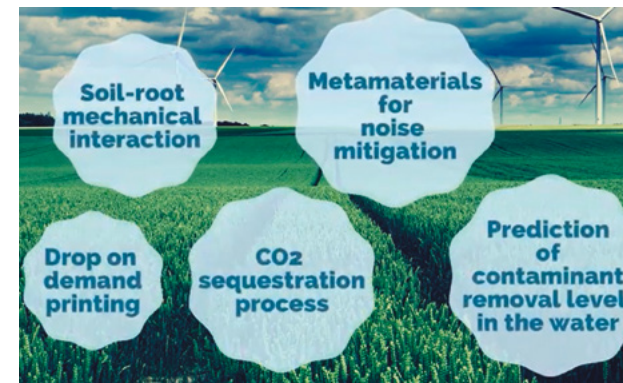
In October 2022, the interim resolution of the call "Strategic projects aimed at the ecological transition and the digital transition 2021" was published by the Spanish Ministry for Science and Innovation and the Research State Agency. In this occasion, CIMNE obtained funding for executing five projects, representing the fifty percent of the proposals submitted to this call.

Further information on cimne.com/vnews/11735

CIMNE participates in the 30th Anniversary of the UNITWIN/UNESCO Chairs Programme

CIMNE took part in the event "Transforming knowledge for just and sustainable futures" which gathered the members of the UNITWIN/UNESCO Chairs Programme to celebrate its 30th anniversary in the premises of the UNESCO at Paris from 3rd to 4th November, 2022. Since 1989, CIMNE hosts the first Chair created within its network.

Further information on cimne.com/vnews/11756

CIMNE renews its Equality Plan

CIMNE approved the renewal of its Equality Plan for the period 2022-2026. This is the second Equality plan promoted by CIMNE with objetive of guarantee full gender equality opportunities and ensure that any person in the centre is valued based on their profile and professional performance without distinction of gender, age, race, belief or personal or circumstantial variables.

Further information on cimne.com/vnews/11673

CIMNE in Numbers 2022

4 Postgraduate studies	**13** PhD Theses defended	**11** Conferences	**12** Seminars
7 Courses	**12** Coffee Talks	**166** Publications	**30** Aulas CIMNE
53 new contracts with the industry *(106 ongoing)*	**1** new patent *(11 in total)*	**14** spin-off companies	**85** ongoing competitive projects

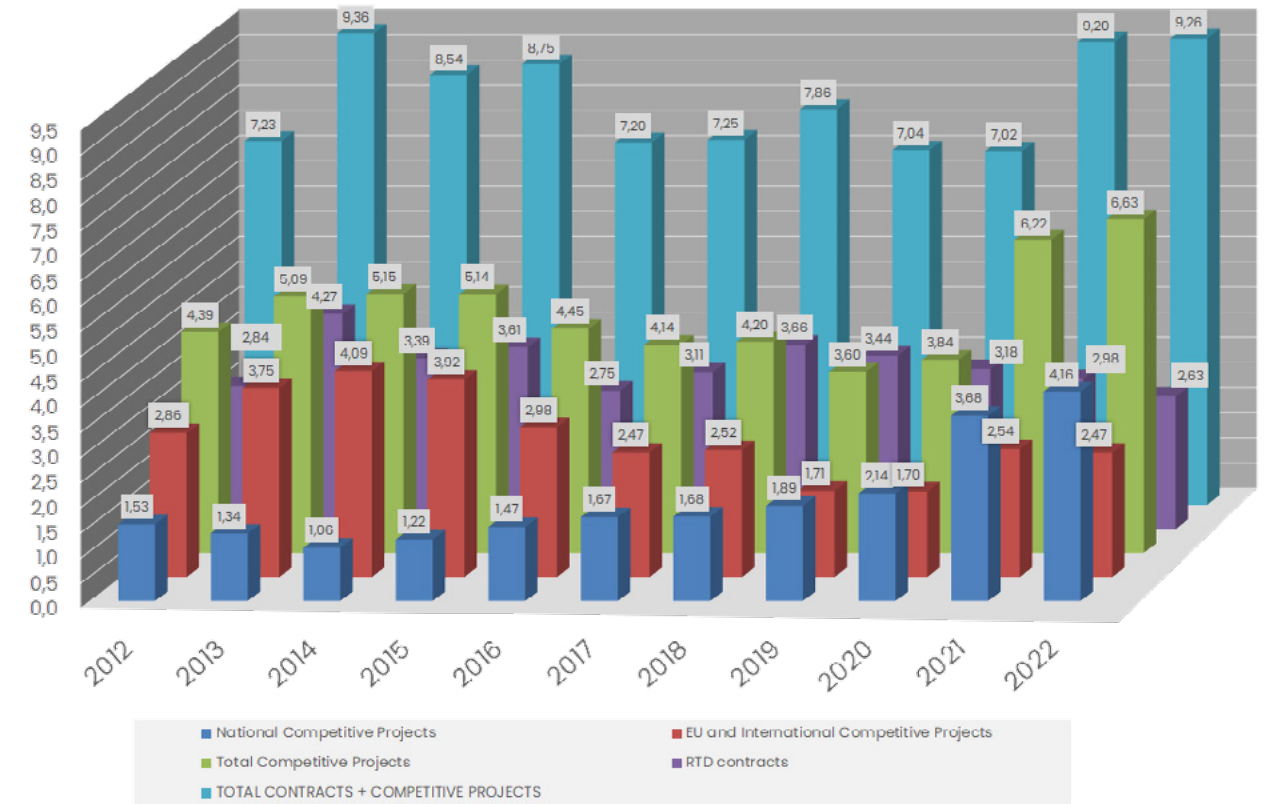## Income from contracts and competitive projects (2012-2022)
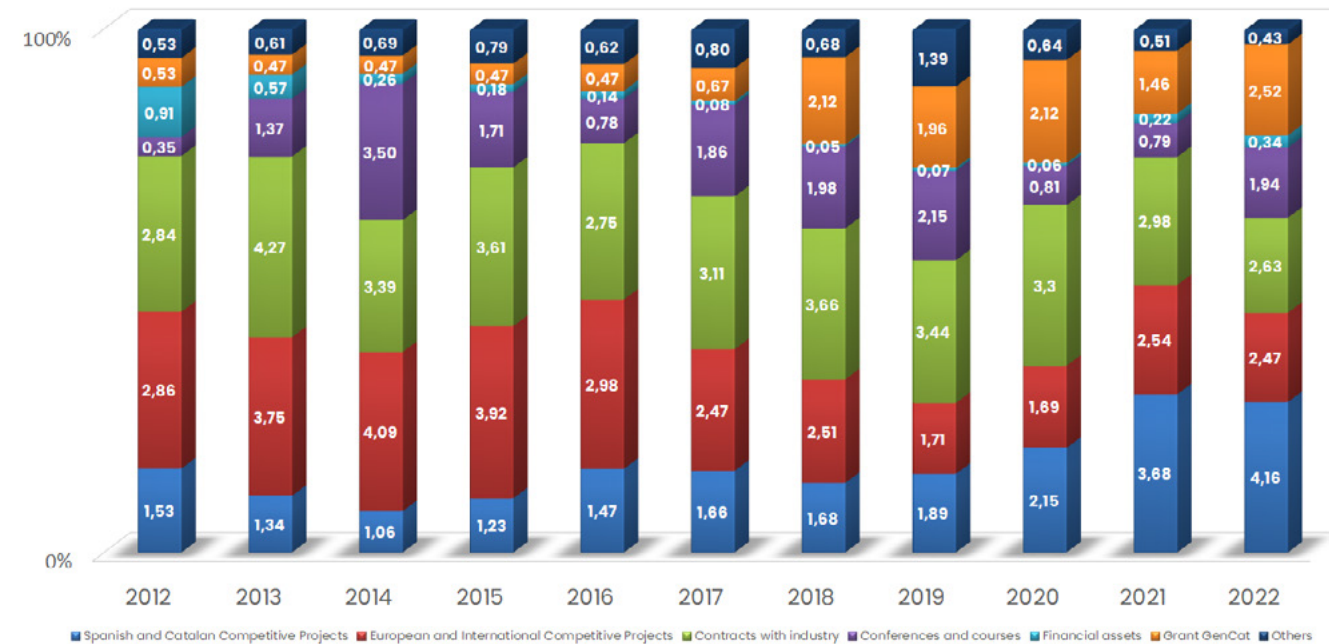*Data: May 2023 (audit pending)* — in M€

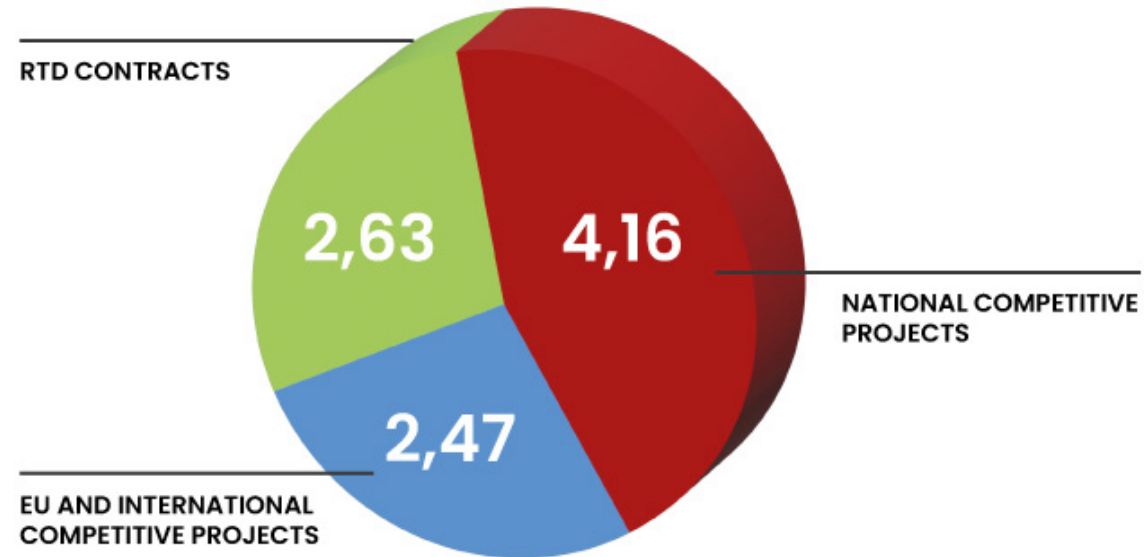## Split of annual income (2012-2022)
Data: May 2023 (audit pending) — in M€

Income from contracts and competitive projects in 2022

*Data: May 2023 (audit pending)

in M€

- **RTD CONTRACTS** — 2,63
- **NATIONAL COMPETITIVE PROJECTS** — 4,16
- **EU AND INTERNATIONAL COMPETITIVE PROJECTS** — 2,47

Evolution Annual Income (1987-2022)

*Data: May 2023 (2022 audit pending)

in M€

Year	Value
1987	0,05
1988	0,4
1989	0,75
1990	0,95
1991	1,51
1992	2
1993	1,82
1994	1,88
1995	1,85
1996	1,83
1997	2,77
1998	3,56
1999	3
2000	3,85
2001	3,81
2002	6,07
2003	5,25
2004	4,61
2005	5,69
2006	5,84
2007	9,45
2008	10,64
2009	10,08
2010	10,23
2011	12,2
2012	9,55
2013	12,38
2014	13,46
2015	11,91
2016	9,21
2017	10,65
2018	12,68
2019	12,61
2020	10,77
2021	12,18
2022	14,48

cimne.com/in-numbers
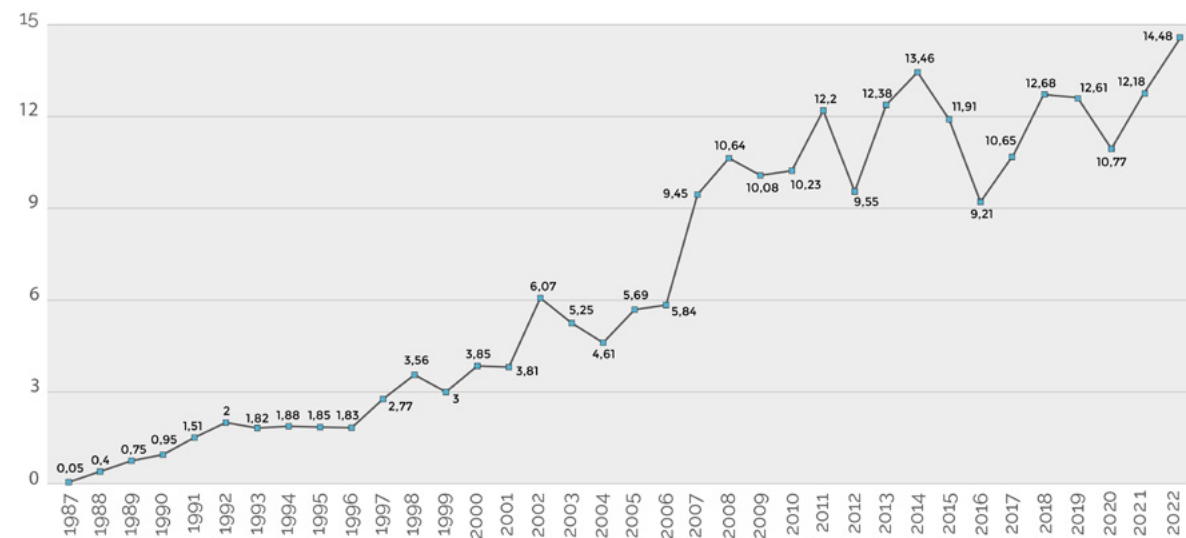
Governing Bodies

Governing Council

President
Hon. Mr. Ester Capella
Minister of Territory and Sustainability (Government of Catalonia)

Representing Catalan Government

Mr. Marc Sanglas
Secretary for Infrastructure and Mobility (Government of Catalonia)

Dr. Joan Gómez Pallarès
Director-General for Research (Government of Catalonia)

Mr. Oriol Alcoba
Director-General for Industry (Government of Catalonia)

Vice-President
Dr. Ferran Falcó

Representing UPC · BarcelonaTech
Dr. Daniel Crespo
Rector (UPC · BarcelonaTech)

Dr. Jordi Llorca
Vice-rector for Scientific Policy (UPC · BarcelonaTech)

Dr. Esther Real
Full Professor (UPC · BarcelonaTech)

Representing UNESCO
Dr. Lluís Ramallo
President of the Spanish Commission of UNESCO

Executive Council - *Finance and Compliance*

Chair
Mr. Ferran Falcó
Vicepresident (CIMNE)

Members
Prof. Javier Bonet
General Director (CIMNE)

Ms. Anna Font
General Manager (CIMNE)

Ms. Teresa Prohias
Director of Services (Gencat-Department of Territory)

Ms. Esther Morales
Deputy General Director of Economic Management, Procurement and Patrimony (Gencat-Department of Research and Universities)

Mr. Ivan Planas
General Manager (UPC · BarcelonaTech)

Mr. Lluís Rovira
Director (iCERCA)

Prof. Gabriel Bugeda
Guest member
Institutional Relations Director (CIMNE)

Mr. Javier Marcipar
Guest member
Director (CIMNE Tecnologia)

Ms. Maricarmen Linares
Guest member
Accounting and Finance Director (CIMNE)

cimne.com/governing-bodies

Executive Council - *Science and Innovation*

Chair
Mr. Ferran Falcó
Vicepresident (CIMNE)

Members
Mr. Jordi Aguasca
Director of the Technological Transformation Unit and Disruption (Gencat-ACCIÓ)

Mr. Marc Darder
Head of the Technical Office (Gencat-Department of Territory)

Prof. Jordi Llorca
Vice-rector of Research (UPC · BarcelonaTech)

Prof. Climent Molins
Vice-rector of Transformation, Innovation and Entrepreneurship (UPC · BarcelonaTech)

Prof. Miquel Soriano
Vice-rector PDI Policy (UPC · BarcelonaTech)

Mr. Lluís Rovira
Director (iCERCA)

Prof. Xavier Sànchez-Vila
Director (DECA / UPC · BarcelonaTech)

Ms. Anna Font
Guest member
General Manager (CIMNE)

Dr. Fernando Salazar
Guest member
Project Development Director (CIMNE)

Prof. Gabriel Bugeda
Guest member
Institutional Relations Director (CIMNE)

Mr. Javier Marcipar
Guest member
Director (CIMNE Tecnologia)

Mr. Jordi Jiménez
Guest member
Head of Technology Transfer (CIMNE)

Scientific Advisory Council

The Scientific Advisory Council (SAC) of CIMNE is formed by prestigious international researchers in the field of numerical methods in engineering.

Its role is to provide advice and guidance to the Executive and Governing Councils of CIMNE on the scientific policy of CIMNE.

Prof. PETER WRIGGERS (Chair)
Leibniz University Hannover, Germany

Prof. FRANCISCO CHINESTA
ENSAM Paris, France

Prof. LAURA DE LORENZIS
ETH Zurich, Switzerland

Prof. JOSEF EBERHARDTSTEINER
Vienna University, Austria

Prof. PÄR JONSEN
Lulea University, Sweden

Prof. MICHAEL KLEIBER
Academy of Sciences, Poland

Prof. RAINALD LOHNER
George Mason University, USA

Prof. MANOLIS PAPADRAKAKIS
National Technical Univ., Athens, Greece
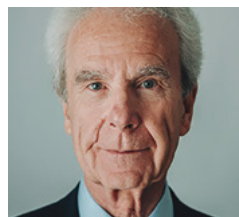
Prof. ESTEFANÍA PEÑA
University of Zaragoza, Spain

Prof. UMBERTO PEREGO
Politecnico di Milano, Italy

Prof. SIMONA PEROTTO
Politecnico di Milano, Italy

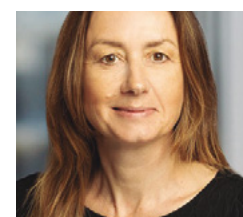**Prof. EKKEHARD RAMM**
Stuttgart University, Germany

Prof. BERNHARD SCHREFLER
Padova University, Italy

Prof. SPENCER SHERWIN,
Imperial College London, UK

Prof. KAREN VEROY
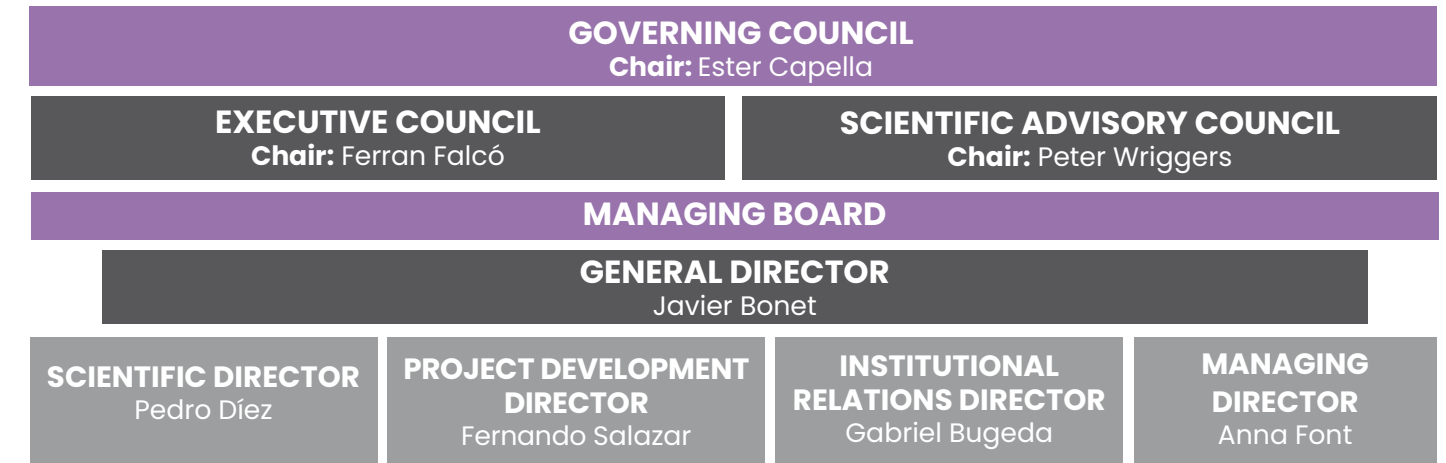Eindhoven University, The Netherlands

Prof. KAREN WILLCOX,
The Oden Institute for Computational Engineering & Sciences, US

Prof. ROLAND WUCHNER
Technical University of Braunschweig, Germany

Organization Chart

GOVERNING COUNCIL	
Chair: Ester Capella	

EXECUTIVE COUNCIL	SCIENTIFIC ADVISORY COUNCIL
Chair: Ferran Falcó	**Chair:** Peter Wriggers

MANAGING BOARD

GENERAL DIRECTOR
Javier Bonet

SCIENTIFIC DIRECTOR	PROJECT DEVELOPMENT DIRECTOR	INSTITUTIONAL RELATIONS DIRECTOR	MANAGING DIRECTOR
Pedro Díez	Fernando Salazar	Gabriel Bugeda	Anna Font

Research and Tech Development (RTD Areas & Groups)

CIVIL AND ENVIRONMENTAL ENGINEERING

Building, Energy and Environment
Leader - Jordi Cipriano

Disaster Risk and Resilience
Leader - Liliana Carreño

Geomechanics
Leader - Marcos Arroyo

Hydrogeology
Leader - Xavier Sánchez Vila

Machine Learning in Civil Engineering
Leader - Fernando Salazar

River Dynamics and Hydrologic Engineering (FLUMEN Institute)
Leader - Ernest Bladé

Structural Mechanics
Leader - Eugenio Oñate

COMPUTATIONAL MATERIALS DESIGN & ANALYSIS

Composites and Advanced Materials for Multifunctional Structures
Leader - Xavier Martínez

Computational Design & Analysis of Engineering Metamaterials
Leader - Xavier Oliver

Mechanics of Electroactive Materials
Leader - Irene Arias

Soft and Living Material Interfaces
Leader - Marino Arroyo

ENGINEERING MECHANICS AND PROCESSES

Bio-Medical Engineering
Leader - Eduardo Soudah

Fluid Mechanics
Leader - Ramon Codina

Industrial Manufacturing Processes
Leaders - Michele Chiumenti and Miguel Cervera

INNOVATIVE ALGORITHMS AND HPC TECHNIQUES

Data-driven high-fidelity modeling
Leader - Pedro Díez

Kratos Multiphysics
Leader - Riccardo Rossi

Large Scale Scientific Computing
Leader - Santiago Badia

TRANSPORT AREA

Aeronautics
Leader - Jordi Pons

CENIT Group for Innovation in Multimodal Transport
Leader - Sergi Saurí

Naval and Marine Engineering
Leader - Borja Serván

INNOVATION SUPPORT AND TECHNOLOGY TRANSFER

Information and Communication Technology
Leaders - Ángel Priegue and Jordi Jiménez

Pre and Post Processing
Leader - Abel Coll

Valorization of Research and Technology Transfer
Leader - Jordi Jiménez

Administration

ACCOUNTANCY AND FINANCES
Leader - Mª Carmen Linares

COMMUNICATION
Leader - Laura Bermúdez

CONGRESS BUREAU
Leader - Mª del Mar Santiago

HUMAN RESOURCES
Leader - Irene Martínez

POST-GRADUATE TRAINING
Leader - Lelia Zielonka

IT-DEVELOPMENT
Leader - Javier Tous

PRE-AWARD UNIT
Leader - Fernando Salazar

PROJECT MANAGEMENT
Leader - Sandra Pérez

PUBLICATIONS
Leader - MªJesús Samper

QUALITY
Leader - Ignacio Valero

SYSTEMS
Leader - Miguel Alonso

CIMNE Staff

This is the list of all persons who collaborate with CIMNE at December 31st 2022

Research and Technology Development

FULL RESEARCH PROFESSORS

Carlos Agelet de Saracibar
Eduardo Alonso
Irene Arias
Marino Arroyo
Santiago Badia
Álex H. Barbat
Javier Bonet
Gabriel Bugeda
Miguel Cervera
Michele Chiumenti
Ramón Codina
Pedro Díez
Antonio Gens
Antonio Huerta
Sergio Idelsohn
Alberto Ledesma
Antonio Lloret
Xavier Oliver
Sebastián Olivella
Sergio Oller
Eugenio Oñate
Enrique Romero
Riccardo Rossi
Xavier Sánchez
Jean Vaunat
Ronald Wüchner
Francisco Zárate

ASSOCIATE RESEARCH PROFESSORS

Marcos Arroyo
Joan Baiges
Ernest Bladé
Juan Carlos Cante
Josep M. Carbonell
Liliana Carreño
Jordi Cipriano
Daniel Di Capua
Àlex Ferrer

Roberto M. Flores
Oriol Lloberas
Jaime E. Martí
Xavier Martínez
José Javier Muñoz
Enrique Ortega
Núria Pinyol
Javier Príncipe
Ivan Puig
Fernando Salazar
Borja Serván

ASSISTANT RESEARCH PROFESSORS

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Ignasi de Pouplana
Narges Dialami
Alessandro Franci
Matteo Giacomini
José Manuel González
Joaquín A. Hernández
Joaquín Irazábal
Gerard Laguna
Julio M. Martí
Lluís Monforte
Javier Mora
Fermín Otero
Jordi Pons
Anna Ramon
Pavel Ryzhakov
Eduardo Soudah
David J. Vicente
Rubén Zorrilla

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Gabriel Barbat
Ramón Barboza
Miguel Calpe
Alejandro Cornejo
Gaia di Carluccio
Juan Marcelo Giménez

Laura González
Hauke Gravenkamp
M. Juliana Knobelsdorf
Xufei Lu
Arisleidy Mesa
Rubén Otin
Raúl Sáez
Muhammad A. Shafique
Daniel Tarragó
Erdem Toprak
Daniel Yago

STAFF SCIENTISTS

Pedro Arnau
Abel Coll
Stoyan Danov
Alessandra Di Mariano
Eloi Gabaldón
Fernando Rastellini
Ramón Ribó
Ramón O. Salomón
Cecilia Soriano

RESEARCH ENGINEERS

Diego Eugenio Aguilera
Barbara Alcayde
Laura Almunia
Matías Alonso
Clara Alvarado
Ferran Arrufat
Allen Bateman
Katia Boschi
José Manuel Broto
Alberto Burgos
Jesús Carbajosa
Jordi Carbonell
Miguel Ángel Celigueta
Alexis Cid
Francesc Contreras
Enrique Escolano
Óscar A. Fruitós
Javier Gárate

Marc Garcia
Luis Miguel García
Javier Garrido
Francesc Gasparín
Vicente Gibert
Luis Antônio Gonçalves
Sergio González
Mohammad Hashemi
Jordi Jiménez
Juan Salvador Latorre
Anyeline León
Mateu Maglia
Genís Majoral
Andrea Manso
África Marrero
Josep Mayós
Adrià Melendo
Anna Monros
Gerard Mor
Gerardo Morales
Carlos A. Moreira
Alejandro Núñez
Sergi Ocón
Rafael Pacheco
Miguel A. Pasenau
Andrés Pastor
Daniel Pérez
Maria Rosa Peyrau
Ángel Diego Priegue
Junior Ramírez
Anaïs Ramos
Andrés Reyes
Jazmín Ríos
Francisco Rodero
Paola K. Rodríguez
Alfonso Rodríguez
Carlos A. Roig
Laura Santos
Marcos Sanz
Josep Sarrate
Núria Sau
Sergi Saurí

Maria Teresa Sellart
Pablo L. Sierra
Clara Soler
Javier Soraluce
Alberto Tena
Pere-Andreu Ubach
Sergio Valero
Ignacio Valero
María Teresa Yubero
Claudio Zinggerling

RESEARCH STUDENTS

PhD Students

Oluwakemi Akinwehinmi
Mohammad Azizpooryan
Hadi Bakhshan
Irene Berdugo
Ashutosh Bijalwan
Pau Blanco
María Jesús Bopp
Álvaro Borràs
Karen L. Casallas
Zulkeefal Dar
Malik Dawi
Danial Dehghan
Maria Montserrat Dolz
Diego E. Duran
Arnau Fabra
Sima Farshbaf
Mariano T. Fernández
Oriol Frigola
Stephan Gahima
Marc Girona
Agustina Giuliodori
Joaquín González
Sthefania Grajales
Maurici Hervas
Sergio Jiménez
Sheraz Ahmed Khan
Sergio Ricardo López
Luan Malikoski
Edgar Alexis Martínez
Ignacio Martínez
Hossein Mohammadi
Samar Momin
Aníbal Andrés Moncada

Christian Narváez
Rafael Nazareth
Rafel Perelló
Saman Rahmani
Mohammad Razavi
Iván Rivet
Raúl Rubio
Gastón Sal
Aniol Sala
Jatna A. Sánchez
Sebastián Sandoval
Chiara Saragani
Samra Sarwar
Babak Sayad
Chengshun Shang
Laurence Henry Sigler
Nathalia Silva
Mehdi Slimani
Guillermo Solina
Fermnando A. Sossa
Alireza Taherzadeh
Francesc Turón
Henning Venghaus
Pablo Nicolas Wierna
Davood Yazdani
Buse Yetisti
Wanchang Zhang
Marco Antonio Zúñiga

Undergraduate Students

Ton Creus

VISITING SCIENTISTS

CIMNE promotes the visits of academics and researchers from around the world. Visiting Scientists at CIMNE in 2022:

Visiting Scientists

Rainald Lohner
Norberto Nigro
Rogelio Ortigosa
Jacques Periaux

Administration staff

GENERAL DIRECTOR
Javier Bonet

SCIENTIFIC DIRECTOR
Pedro Díez

PROJECT DEVELOPMENT DIRECTOR
Fernando Salazar

DIRECTOR FOR INSTITUTIONAL RELATIONS
Gabriel Bugeda

MANAGING DIRECTOR
Anna Font

Administration staff in CIMNE is formed by highly qualified professionals who address the increasing needs of researchers and scientific personnel in the centre.

ACCOUNTANCY AND FINANCES
Mª Carmen Linares
(Head of Unit)
Katherine J. Brenes
Elisabet Laya
Cristina Luque
Jon Rodríguez

COMMUNICATION
Laura Bermúdez

CONGRESS BUREAU
Mª del Mar Santiago
(Head of Unit)
Alessio Bazzanella
Gemma Barberillo
Mónica Camanforte
Sergi Gumà
Sergio Olivares
Beatriz Rodríguez

DIRECTOR SECRETARY
Laura Rangel

HUMAN RESOURCES
Irene Martínez
(Head of Unit)
Mar Mesa

PROJECT MANAGEMENT
Sandra Pérez
(Head of Unit)
Marina de la Cruz
Francisco de la Rosa
Carla Fadlallah
Mahavir Singh
Gerard Vilar

POSTGRADUATE TRAINING
Lelia Zielonka
(Head of Unit)
Cristina Pérez

PUBLICATIONS
MªJesús Samper
(Head of Unit)
Jesús Sánchez

RECEPTION
Jordi López

SYSTEMS
Miguel Alonso
(Head of Unit)
Aitor Lázaro
Oscar Ruiz
Gianfranco Sáenz

TECHNICAL STAFF
Sergio Chacón
Jacqueline E. Davies
Andreu Marí
Javier Tous

TECHNOLOGY TRANSFER
Jordi Jiménez
Javier Marcipar
Sergio Otero

Where we are

Headquarters

B0 Building at Campus Nord UPC Barcelona

Photos: C1 Building at Campus Nord UPC Barcelona

Main premises at UPC

CIMNE's main premises are located at the heart of the North Campus of Universitat Politècnica de Catalunya · BarcelonaTech.

The offices are situated at the C1 Building, adjacent to the Civil Engineering School of UPC and occupy some 1,000 m² of modern office facilities and state of the art equipment with last generation computers linked via a fast intranet and a multicore cluster for parallel computing.

This space, created in 1987, hosts around 90 CIMNE researchers and the main administration offices.

CIMNE-BARCELONA
Campus Nord UPC, C1 Building
C/ Gran Capità, S/N, 08034 Barcelona, Spain
+34 93 401 74 95

B0 Building

In September 2014 CIMNE started the construction of a new building of some 2,000 m² in the North Campus of the Universitat Politècnica de Catalunya · BarcelonaTech.

The B0 building, that also hosts the Flumen Institute, was completed by the end of 2015. Several CIMNE researchers moved to the new facilities in 2016. This new building is equipped with modern experimental facilities for model scale testing of river dynamic and hydraulic problems and it also provides work areas for researchers at the graduate level (master, doctoral and postdocs) and for senior researchers from CIMNE and UPC · BarcelonaTech.

CIMNE-B0
Campus Nord UPC, B0 Building
C/ Gran Capità, S/N, 08034 Barcelona, Spain
+34 93 401 09 50

Premises in Spain

CIMNE - Terrassa

CIMNE offices in Terrassa (Barcelona, Spain) opened in 2001. The premises cover an area of 150m² and house part of the department of Building Energy and Environment Group (Bee-Group).

Director: J. Cipriano

Address
Campus de Terrassa UPC
Edifici GAIA (TR14)
C/ Rambla Sant Nebridi, 22
08222 Terrassa (Barcelona), Spain
+34 93 789 91 69

CIMNE - Castelldefels

CIMNE's headquarters in the city of Castelldefels (Barcelona, Spain) were inaugurated on October 15th 2008. The facilities are located in the building CIMNE-C3 of the Mediterranean Technology Park of the UPC, and occupy 1,500m² in a new building constructed in collaboration with the UPC. The premises are shared with the Technical School of Castelldefels.

Director: J. Mora

Address
Campus del Baix Llobregat UPC
CIMNE Building C3
C/Esteve Terradas, 5
08860 Castelldefels, Barcelona, Spain
+34 93 413 41 86
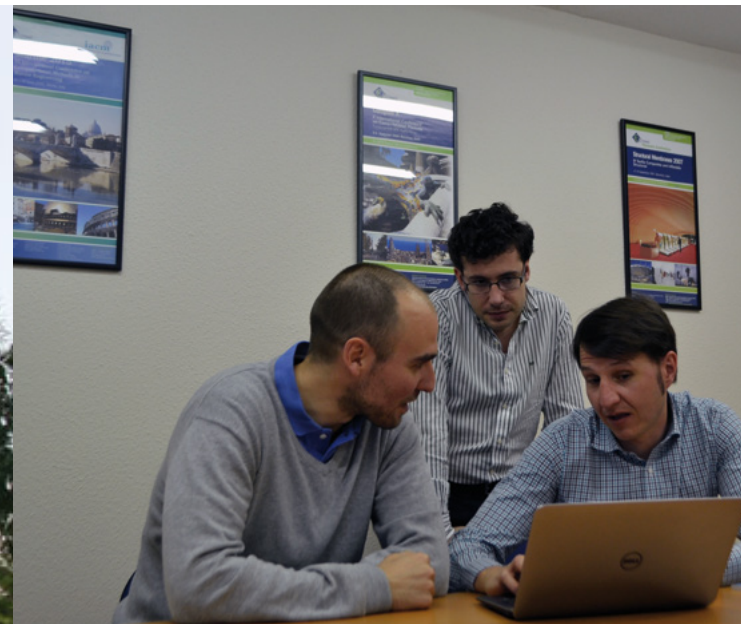
CIMNE - Madrid

CIMNE - MADRID started its activities in September 2007 and on May 2008 CIMNE opened its premises located in the centre of the city (150m²). The main goal of CIMNE Madrid is to build a strong research team in Madrid and foster the links between CIMNE, the Central Government of Spain, the Technical University of Madrid (UPM) and partner companies and research centres based in Madrid.

Director: F. Salazar

Address
Paseo General Martínez Campos, 41, 9º
28010 Madrid, Spain
Tel. +34 91 319 13 59

CIMNE - Lleida

CIMNE's premises in Lleida are located at the Parc Agrobiotech, one of the main scientific and technological platforms of the agri-food sector and ICT in the Catalan and national sphere.

Director: J. Cipriano

Address
Parc Agrobiotech Lleida
Turó de Gardeny, H3 Bulding,1st floor, wing A, office 11
25003 Lleida, Spain
+34 694 484 777

International Branches

CIMNE-USA (Washington DC, USA)

CIMNE-USA is an educational and scientific research organization, affiliated with the International Centre for Numerical Methods in Engineering (CIMNE).

The objective of CIMNE-USA is leading scientific research and development projects supported by government, foundations and industry sources.

The branch also carries out educational activities related to advanced numerical methods. It participates in national and international conferences and symposia and works jointly with Aulas CIMNE, in cooperation with US and international universities. CIMNE-USA also supports visiting scientists.

Dr. David Cranmer (on the left side photo), CIMNE US Acting Executive Director, is a senior scientist at the National Institute of Standards and Technology (NIST) and advisor of many US companies. Mr. Varadaraju (Raju) Gandikota (on the right side photo) is CIMNE USA Scientific Director.

CIMNE-Latin America (Santa Fe, Argentina)

Project Laguna Paiva
Hydrodynamic study
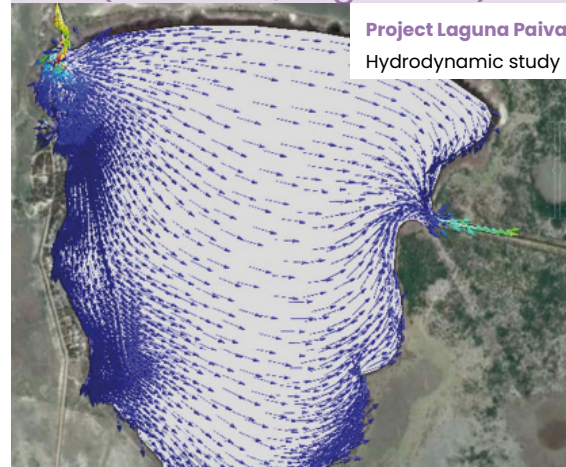
CIMNE is represented in Latin America by the CIMNE Iberoamérica Foundation (CIMNE Iber).

CIMNE Iber is located at the city of Salta in Argentina. It was created in 2020 with strong support from the University of Salta and other local academic organizations in the region. It is also supported by the CIMNE Classroom in University of Salta.
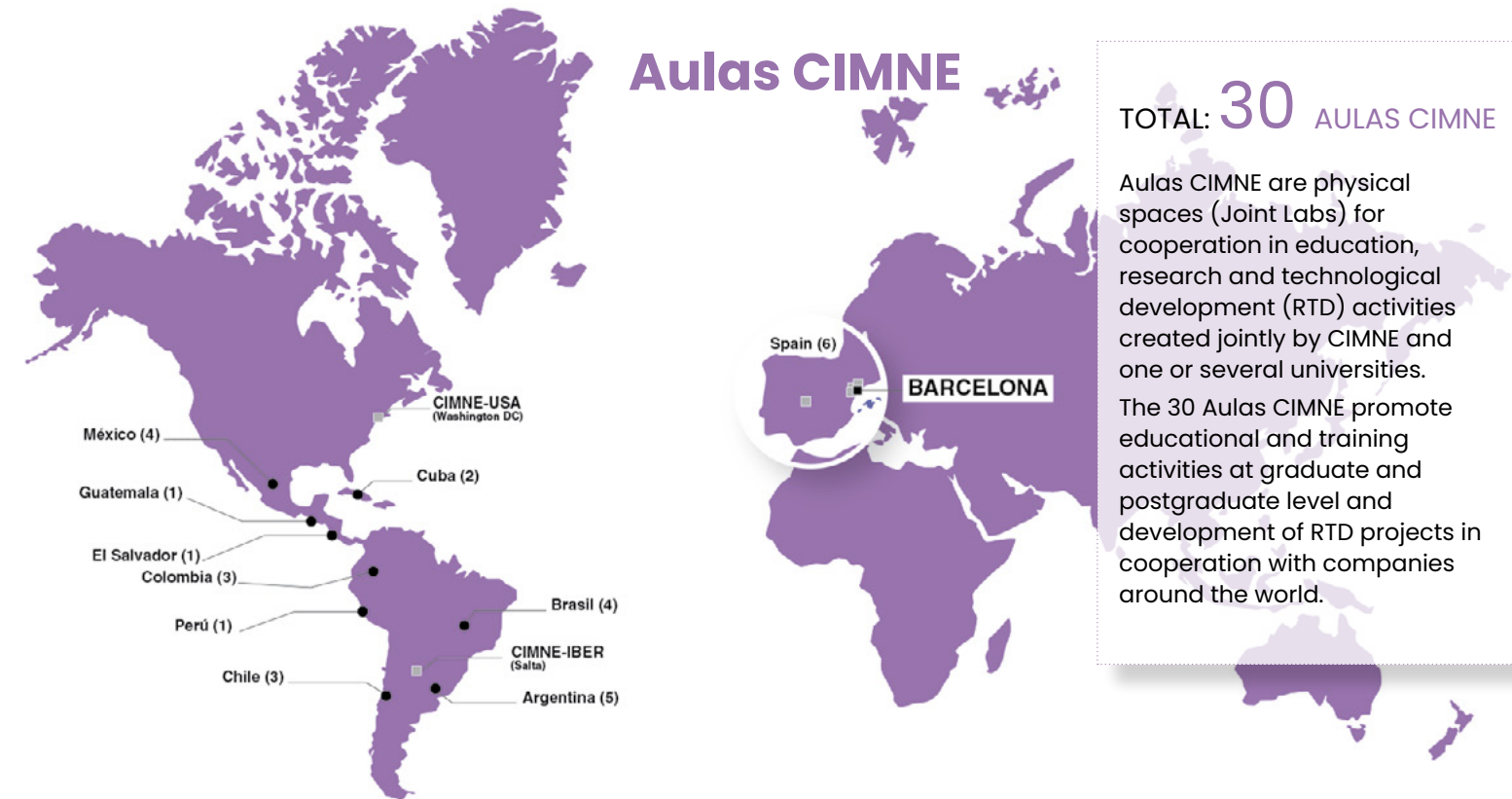
The director of CIMNE Iber is Prof. Sergio Oller, a Full Research Professor at CIMNE for over 25 years.

CIMNE Iber aims to developing and disseminating research activities in the field of numerical methods in engineering in cooperation with CIMNE and other academic organizations. It has also a strong vocation for supporting industry in the development of innovative solutions.

CIMNE Iber will also play an important role in fostering and coordinating tha activities of the CIMNE Classroom Network in the Latin American region.

Aulas CIMNE

TOTAL: **30** AULAS CIMNE

Aulas CIMNE are physical spaces (Joint Labs) for cooperation in education, research and technological development (RTD) activities created jointly by CIMNE and one or several universities.

The 30 Aulas CIMNE promote educational and training activities at graduate and postgraduate level and development of RTD projects in cooperation with companies around the world.

ARGENTINA (5)

AULA FICH – CIMNE
Universidad Nacional del Litoral | Director: Gerardo Franck | Created in October 2002
Activity: Applications of numerical methods to problems related to water resources, mechanical and computer engineering.

AULA ITBA – CIMNE
Instituto Tecnológico de Buenos Aires | Director: Sebastián d'Hers | Created in April 2015
Activity: Application development of numerical methods in different fields (mechanical, naval, petroleum, etc.)

AULA UNER – CIMNE
Universidad Nacional de Entre Ríos | Director: José Di Paolo | Created in March 2013
Activity: Applications of numerical methods to problems related to Bioengineering.

AULA UNSA – CIMNE
Universidad Nacional de Salta | Director: Sergio Oller | Created in April 2008
Activity: Development of computer models for application in civil engineering.

AULA FACET – CIMNE
Universidad Nacional de Tucumán | Director: Eduardo Martel | Created in November 2002
Activity: Development of computational models in civil engineering and bioengineering.

BRAZIL (4)

AULA FEMEC – CIMNE
Universidad Federal de Uberlândia | Director: Gilmar Guimarães | Created in April 2004
Activity: Forming process applications, structural design and biomechanics.

AULA Infralab – CIMNE
Universidade de Brasília | Director: Márcio Muniz | Created in 2016
Activity: Applications of numerical methods in engineering problems.

AULA IFSP – CIMNE
Instituto Federal de Educaçao, Ciéncia e Tecnologia de Sao Paulo | Director: Kauê Reis dos Santos
Created in July 2009
Activity: Applications of numerical methods in engineering problems in forming processes, solid mechanics and biomechanics.

AULA IFG – CIMNE
Instituto Federal de Educaçao, Ciéncia e Tecnologia de Goiás | Director: Ecio Duarte Naves | Created in October 2018
Activity: Applications of numerical methods in engineering problems.

CHILE (3)

Aula DIMEC-CIMNE
Universidad Técnica Federico Santa María | Director: Franco Perazzo | Created in March 2004
Activity: Numerical methods in mechanical engineering. Development of numerical methods without mesh. Applications in Engineering.

AULA FIULS (Chile)
Universidad La Serena | Director: Carlos Garrido | Created in 2019
Activity: Applications of numerical methods to problems in Engineering.

AULA PUCV (Chile)
Pontificia Universidad Católica de Valparaíso | Director: Juan Carlos Vielma | Created in October 2017
Activity: Numerical Methods for the evaluation of seismic vulnerability of structures, dynamic response of non-linear structures and pre-seismic reinforcement techniques.

COLOMBIA (3)

AULA UNC – CIMNE
Universidad Nacional de Colombia | Director: Jairo Andrés Paredes | Created in June 2005
Activity: Numerical methods applied to civil engineering.

AULA UNIMAR – CIMNE
Universidad Mariana de Colombia | Director: Diego Valencia | Created in May 2018
Activity: Structural analysis.

AULA UNIANDES – CIMNE
Universidad de los Andes | Director: René Meziat | Created in January 2003
Activity: Teaching and research in numerical methods, optimization, variational principles and computational mechanics.

CUBA (2)

AULA UCI – CIMNE
Universidad de las Ciencias Informáticas | Director: Jorge Gulín | Created in October 2015
Activity: Development of computational models and tools with application in high performance computation.

AULA UCLV – CIMNE
Universidad Central de las Villas | Director: Carlos Recarey | Created in July 2003
Activity: Modelling and analysis of structures and grounds to the application of numerical methods.

EL SALVADOR (1)

AULA UCA – CIMNE
Universidad Centroamericana "José Simeón Cañas" | Director: Mauricio Pohl | Created in Feb. 2010
Activity: Civil engineering applications and multi objective optimization and applications.

GUATEMALA (1)

AULA UMG – CIMNE
Universidad Mariano Gálvez | Director: Rolando Torres | Created in February 2011
Activity: Development of computer models for application in civil engineering.

SPAIN (6)

AULA EEBE – CIMNE
Escola d'Enginyeria de Barcelona Est | Director: Daniel Di Capua | Created in July 2017
Activity: Development of numerical methods in industrial and civil engineering.

AULA ESEIAAT – CIMNE
UPC · BarcelonaTech Terrassa | Director: Óscar Fruitós | Created in April 2007
Activity: Industrial and aeronautical engineering

AULA ETSII – CIMNE
Universidad Politécnica de Madrid | Director: Jorge Rodríguez-Chueca | Created in February 2021
Activity: Development and applications of numerical methods in aliviar engineering

AULA ETSINO – CIMNE (Spain)
Universidad Politécnica De Cartagena | Director: José Gutiérrez | Created in May 2018
Activity: Development of numerical naval engineering.

AULA FNB – CIMNE (Spain)
Facultad de Náutica de Barcelona | Director: Julio García | Created in March 2002
Activity: Applications of numerical methods to problems related to marine engineering.

AULA UPM – CIMNE (Spain)
Universidad Politécnica de Madrid (UPM) | Director: Rafael Morán | Created in May 2010
Activity: Applications of numerical methods in civil engineering.

Biomass Laboratory IKIAM / CIMNE (Ecuador)

MÉXICO (4)

AULA CIMAT – CIMNE
Centro de Investigaciones en Matemáticas | Director: Salvador Botello | Created in June 2006
Activity: Applied mathematics, numerical methods, engineering and statistical analysis.

AULA UGTO – CIMNE
Universidad de Guanajuato | Director: Humberto Esqueda | Created in January 2002
Activity: Civil engineering applications and multi objective optimization and applications.

AULA MORELIA – CIMNE
Universidad Michoacana de San Nicolás de Hidalgo | Director: Francisco Domínguez | Created in October 2015
Activity: Civil, mechanic and electric engineering.

AULA TEC – CIMNE
Instituto Tecnológico de Monterrey | Director: Juan Álvarez | Created in 2021
Activity: Structural analysis.

PERU (1)

AULA PUCP – CIMNE
Universidad Católica de Perú | Director: Rosendo Franco | Created in April 2009
Activity: Modelling and analysis of structures and grounds to the application of numerical methods.

CIMNE, Centre of Excellence Severo Ochoa

Research

EXCELENCIA SEVERO OCHOA

CIMNE has reinforced and reorganized its current research activities in order to contribute to overcome

Four Scientific Challenges of high impact to the welfare of citizens:

*The period for granting the Severo Ochoa accreditation for CIMNE goes from 15th December 2019 to 15th December 2024

The International Centre for Numerical Methods in Engineering received the Severo Ochoa accreditation in December 2019*. CIMNE became thus one of the six "Centre for Excellence Severo Ochoa" accredited by the Spanish State Research Agency (attached to the Spanish Ministry of Science, Innovation and Universities).

By creating excellent centres, the Ministry of Science and Innovation aims to promote high-impact research carried out in the R&D centres of Spain.

Severo Ochoa Centres stand out both for the international notoriety of the scientific contributions they make, and for their innovative capacity and their intense relationship with the business sector. They are also world reference centres capable of attracting international talent.

Research Challenges & Goals

4 Research Challenges (*)

(*) These challenges are aligned with the research and technical development (RTD) priorities of European Commission (EC) H2020 priorities and the Plan Estatal de Investigación Científica y Técnica y de Innovación 2017-2020.

RCh1. CONSTRUCTION & TRANSPORT:
The enhanced design of buildings and constructions, transport infrastructure and vehicles.

RCh2. ENVIRONMENT, ENERGY & SECURITY:
A more environmentally-friendly and safer planet.

RCh3. MANUFACTURING:
A more competitive industrial sector.

RCh4. MATERIALS:
The development of new materials with functional properties for engineering applications.

RCh1 - CONSTRUCTION & TRANSPORT

Enhanced design of buildings, constructions, transport infrastructure and vehicles.

RCh 1.1. NEW NM FOR ANALYSIS OF CONSTRUCTIONS WITH NEW MATERIALS

Design and construction of new sustainable, safer and affordable buildings and infrastructures.

RCh 1.2. NEW NM FOR ANALYSIS OF CONSTRUCTIONS WITH NEW MATERIAL

Design of new aircrafts with improved features, such as reduced energy consumption and environmental impact, and increased safety of air transport.

RCh 1.3. NEW NM FOR ENHANCED DESIGN OF SHIPS AND MARINE STRUCTURES WITH IMPROVED PERFORMANCE AND ENVIRONMENTAL FEATURES

Design and construction of environmentally friendly and faster ships that can meet the challenges of the maritime transport.

RCh2 - ENVIRONMENT, ENERGY & SECURITY

Towards a more environmental-friendly and safer planet.

RCh 2.1. NM FOR ENVIRONMENTAL BIOTECHNOLOGY

New Numerical Methods for:
- Wetlands for wastewater treatment;
- Water bodies, the atmosphere, animals & lands.
- Surface reactive barriers for reducing the risk of organic compounds to human and ecosystems

RCh 2.2. ADVANCED NM FOR THE PREDICTIVE IMPACT OF HAZARDS ON THE BUILT INFRASTRUCTURE AND THE ENVIRONMENT

Development of NM, fed with information from satellites, drones and monitoring devices at the small scale, processed via Big Data techniques, for studying:
- The effect of water hazards on constructions and landscape.
- The effect of earthquakes on the built environment
- The motion of pedestrians in hazards.
- Air pollution in cities.
- The effect of explosions and fire on structures.
- The creep-like motion and evolution of landslides.
- The vulnerability and resilience of transport networks in hazards.

RCh3 - MANUFACTURING

Numerical Methods for the predictive design of forming manufacturing processes to achieve affordable final products made of metallic and polymer-based materials with the desired functionalities.

- **Applications:** additive manufacturing, sheet stamping, casting, welding, forging, machining, rolling and extrusion, etc.

RCh4 - MATERIALS

Numerical Methods (NM) for analysis and predictive design of multifunctional architected materials.

Development of new materials with functional properties for engineering applications:

- In photonics and acoustics for attenuating selected ranges of frequencies
- To produce ultra-light materials with desired mechanical properties
- Nonlinear metamaterials exhibiting extreme shock absorbing and restitution capacities
- Biological active meta-materials (organ-on-a-chip devices)

RTD Areas and Groups

RTD AREAS AND GROUPS			
CIVIL AND ENVIRONMENT ENGINEERING		**COMPUTATIONAL MATERIALS DESIGN & ANALYSIS**	
BUILDING, ENERGY AND ENVIRONMENT PI: Jordi Cipriano	MACHINE LEARNING IN CIVIL ENGINEERING PI: Fernando Salazar	COMPOSITES AND ADVANCED MATERIALS FOR MULTIFUNCTIONAL STRUCTURES PI: Xavier Martínez	
DISASTER RISK AND RESILIENCE PI: Liliana Carreño	RIVER DYNAMICS AND HYDROLOGIC ENGINEERING (FLUMEN INSTITUTE) PI: Ernest Bladé	COMPUTATIONAL DESIGN & ANALYSIS OF ENGINEERING METAMATERIALS PI: Xavier Oliver	
GEOMECHANICS PI: Marcos Arroyo	STRUCTURAL MECHANICS PI: Eugenio Oñate	MECHANICS OF ELECTROACTIVE MATERIALS PI: Irene Arias	
HYDROGEOLOGY PI: Xavier Sànchez-Vila		SOFT AND LIVING MATERIAL INTERFACES PI: Marino Arroyo	
ENGINEERING MECHANICS AND PROCESSES		**INNOVATION SUPPORT AND TECHNOLOGY TRANSFER**	
BIO-MEDICAL ENGINEERING PI: Eduardo Soudah		INFORMATION AND COMMUNICATION TECHNOLOGY PIs: Ángel Priegue and Jordi Jiménez	
FLUID MECHANICS PI: Ramon Codina		PRE AND POST PROCESSING PI: Abel Coll	
INDUSTRIAL MANUFACTURING PROCESSES PIs: Michele Chiumenti and Miguel Cervera		VALORIZATION OF RESEARCH AND TECHNOLOGY TRANSFER PI: Jordi Jiménez	
INNOVATIVE ALGORITHMS AND HPC TECHNIQUES		**TRANSPORT**	
DATA-DRIVEN HIGH-FIDELITY MODELING PI: Pedro Díez		AERONAUTICS PI: Jordi Pons	
KRATOS MULTIPHYSICS PI: Riccardo Rossi		CENIT - INNOVATION IN TRANSPORT PI: Sergi Saurí	
LARGE SCALE SCIENTIFIC COMPUTING PI: Santiago Badia		NAVAL AND MARINE ENGINEERING PI: Borja Serván	

Building, Energy and Environment

The Building Energy and Environment Group (CIMNE BEE Group) involves over 15 researchers (Physics, Engineering, ICT and Statistics specialists). It was founded in 2001 and has two main offices, one in the GAIA building of the UPC Campus in Terrassa and the other in the Agrobiotech Park in Lleida.

CIMNE BEE Group scouts the science world looking for knowledge and inspiration. Developing better building energy management by improving precision, providing faster response, setting up adaptive and predictive control and making buildings more responsive to users' requirements and wishes.

Making energy data more useful to professionals and companies by reducing cost and increasing applicability and reliability through Big Data Analytics, personalized energy services and adaptive visual interfaces and mobile applications.

BEE Group collaborates with national and international leading research centres and public and private companies to develop research projects related with energy, buildings and the environment.

Research

Demand response in buildings
PI: Gerard Mor

Energy empowerment and user behavior
PI: Stoyan Danov

Big data analytics for energy efficiency in buildings
PI: Jordi Carbonell

Bio-digesters
PI: Jaime Martí

Energy communities and Energy positive municipalities
PI: Jordi Cipriano

Staff

Jordi Cipriano (Leader)

José Manuel Broto	Álvaro Luna - UPC
Jordi Carbonell	Jaime E. Martí
Francesc Contreras	Edgar Alexis Martínez
Stoyan Danov	Josep Mayós
Eloi Gabaldón	Gerard Mor
Marc Girona	Daniel Pérez
Gerard Laguna	María Teresa Sellart
Florencia Lazzari	

On-going RTD Projects

BIGG - Building Information aGGregation, harmonization and analytics platform
EC - H2020 - SC3-Secure, clean & efficient energy
Coordinator: REALDOLMEN NV - *01/12/2020 - 30/11/2023*

EKATE - Gestión de Energía Eléctrica Fotovoltaica y Autoconsumo Compartido en la zona transfronteriza Francia-España, utilizando tecnología "Blockchain" e "Internet of Things (IoT)
EC - Interreg POCTEFA
Coordinator: ESTIA - *01/01/2019 - 31/05/2022*

EN-TRACK - Energy Efficiency Performance-Tracking Platform for Benchmarking Savings and Investments in Buildings
EC - H2020 - SC3-Secure, clean & efficient energy
Coordinator: CIMNE - *01/11/2020 - 31/10/2023*

ePLANET - European Public Local Authorities' Network for driving the Energy Transition
EC - H2020 - SC3-Secure, clean & efficient energy
Coordinator: CIMNE - *01/09/2021 - 31/08/2024*

GAVIUS - From reactive to proactive public administrations
EC - UIA Initiative
Coordinator: Ajuntament de Gavà
01/09/2019 - 31/08/2022

FEM IOT - Valorització de les dades de la IoT (P2)
GENCAT - Activitats Emergents
Coordinator: CIMNE - *31/12/2019 - 28/02/2022*

PIPLATES - Plataforma de Predicció Territorial
GENCAT - Tecnologies Digitals Avançades
Coordinator: CIMNE - *01/07/2021 - 30/12/2022*

SENSEI - Smart Energy Services Integrating the Multiple Benefits from Improving the Energy Efficiency of the European Building Stock
EC -Interreg POCTEFA
Coordinator: IEECP - *01/01/2019 - 28/02/2023*

Technology transfer

The BEE Group collaborates with national and international companies and institutions since 2001, a long journey with some 50 national and international RTD projects that has carried on a trade to emerge two new business "Start-ups": Inergy (created in 2012) and Beedata Analytics (created in 2017).

Further information at "Spin-off Companies" section at page 80.

For the last few years, the BEE Group started a technology transfer process towards two institutions belonging to the Catalan regional government, the Catalan Institute of Energy (ICAEN), and the public company Infraestructures.cat. These processes will help both institutions set up their digital infrastructure to support energy services and energy-conservative measures over all the administrative buildings of the Generalitat de Catalunya.

Disaster Risk and Resilience

The Disaster Risk and Resilience Group (DRR Group) focuses on the development of prospective models to estimate possible economic and human losses caused by events with a natural and anthropogenic origin. This includes the development of multi-hazard catastrophe risk models at different scales and the use of a multidisciplinary and comprehensive framework that considers socio-economic and lack of resilience indicators.

Current global agendas encourage countries, regions, and cities to manage disaster risk and design climate change adaptation strategies. For that, risk assessments with probabilistic approaches and the development and application of indicators about resilience and disaster risk management provide valuable information to monitor progress in a quantitative manner.

The objective of the DRR Group is to provide approaches, tools, and frameworks to be used in comprehensive risk assessments aiming to have a more resilient society.

The DRR Group collaborates with several multi-lateral organizations and has been actively engaged in research, consulting, and capacity building activities in different world regions.

Research

- Disaster risk assessments at different scales.
  PI: Liliana Carreño

- Development of indicators for disaster risk evaluation, resilience and disaster risk management.
  PI: Liliana Carreño

- Integration of catastrophe models with financial instruments. **PI: Mario A. Salgado**

- Probabilistic Seismic Hazard Analysis
  PI: Mario A. Salgado
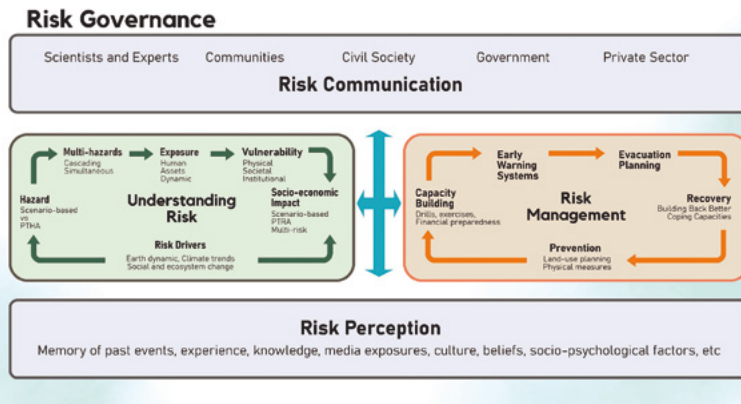
Figure from the paper Tsunami risk communication and management: Contemporary gaps and challenges. Rafliana, I et al., 2022.

On-going RTD Projects

PIPLATES (2021) - Plataforma de Predicció Territorial
GENCAT - Tecnologies Digitals Avançades
Coordinator: CIMNE - *01/07/2021 - 30/12/2022*

Collaboration agreements

Cálculo para la reevaluación de los espectros de piso de los edificios de control y auxiliar de la C.N. de Vandellòs II, mediante la modelización de los edificios, ANAV.

Staff

M. Liliana Carreño (Leader)
Alex Barbat
Sthefania Grajales
Samar Momin
Sergio Oller
Brain Junior Ramírez
Mario A. Salgado

Geomechanics

The research work of the Geomechanics Group focuses on the contribution to fundamental understanding and modelling of soil and rock behavior, the development of advanced computational tools and testing techniques at laboratory scale and the participation in applied engineering projects.

The research of the group and the developed software are a reference in the analysis of coupled thermal, hydraulic, mechanical and chemical processes in porous media applied to the analysis and design of underground structures (tunnels, foundations, geo-reservoirs, etc), earth and rockfill dams and fluid-soil-structure interaction problems.

Research

- Coupled multi-physical analyses of porous media. Application to radioactive waste disposal.
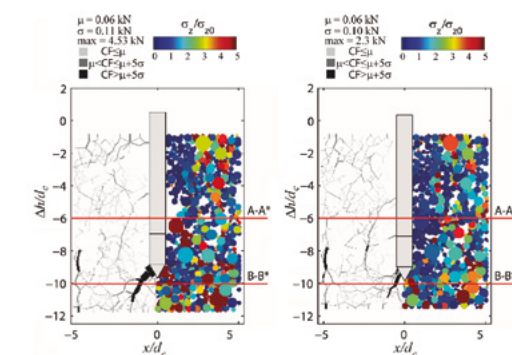 **PIs: Sebastià Olivella** and **Antonio Gens**
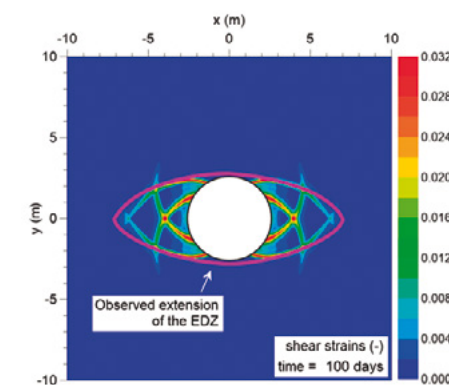
- Analysis and modelling of tailings dams.
  PIs: Marcos Arroyo, **Daniel Tarragó** and **Antonio Gens**
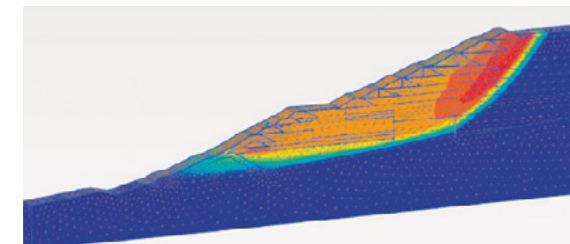

- Numerical analysis of large-scale infrastructure projects. **PI: Antonio Gens**

- DEM and PFEM modelling of penetration problems in Geomechanics. **PIs: Marcos Arroyo and Antonio Gens**

- Advance image analysis techniques for laboratory experiments in soils including large displacements and deformations. Measurements of degree of saturation based on infrared-images.
  PI: Núria M. Pinyol
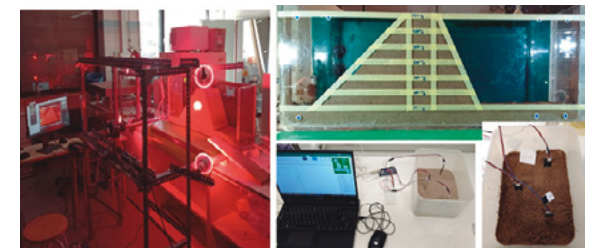
- Thermal-hydro-mechanical large deformation problems in porous media. Development of a Material Point Method open source code. **PI: Núria M. Pinyol**

  - Thermal accelerated seismic-induced-landslides.
  - MPM modelling of flow-landslides.
  - Design and construction of a geotechnical drum centrifuge for evaluating physical models subjected to large displacements and deformations.


- Unsaturated Soil Mechanics. Experimental and theoretical advances. Application to embankments, dams and radioactive waste disposal. **PI: Eduardo Alonso.**

- Rockfill Mechanics. Particle breakage. Relative humidity effect. DEM modelling. **PI: Eduardo Alonso**

- Multi-scale experiments and analyses of geomaterials. **PIs: Enrique Romero** and **Laura González Blanco**

- Multi scale analysis of low-carbon soil binders. **PIs: Alessandro Fraccica, Enrique Romero, & Marcos Arroyo**
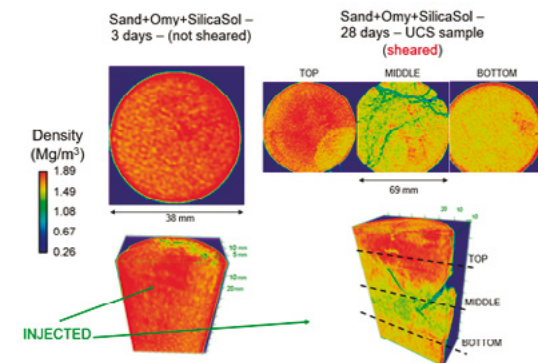
- Multi-physics experiments and modelling of geomaterials. **PIs: Enrique Romero** and **Laura González Blanco**

- Cracking in desiccating soils. **PIs: Alberto Ledesma** and **Pere Prat**

- Crystal Growth in sulphated soils and rocks. Swelling and structure interaction. **PI: Anna Ramon**
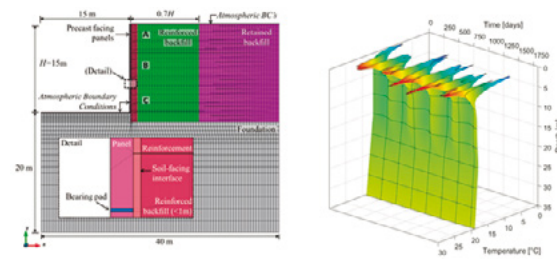
- Effects of Vegetation on the hydro-mechanical behaviour of soils. **PIs: Enrique Romero and Alessandro Fraccica**
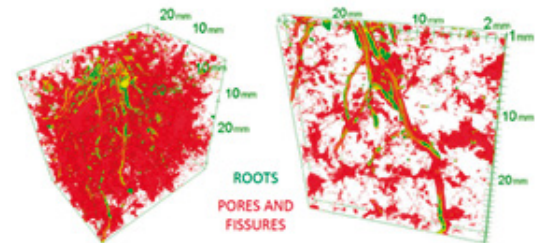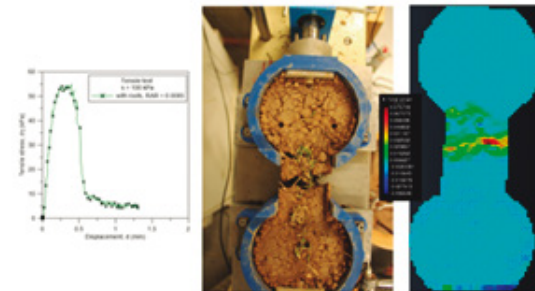
- Coupled modelling of polymeric reinforced geotechnical structures subjected to environmental conditions. **PIs: Ivan P. Damians, Aníbal Moncada and Sebastià Olivella**

Ongoing projects

EURAD - European Joint Programme on Radioactive Waste Management – H2020 (2014-2020) – EURATOM Coordinator: AALTO - *01/06/2019 - 31/05/2024*

ANHY_RISK - Risk prediction and safe design in anhydritic rocks – MCIU – Retos Investigación Coordinator: CIMNE - *01/09/2019 - 31/08/2022*

ANHYROCK - Mecanismos de expansión y criterios de diseño en rocas anhidríticas MICINN - Generación de Conocimiento Coordinator: CIMNE - *01/09/2022 - 30/08/2026*

MAKE-UP ANURA3D - Towards a user-friendly and efficient open-source code Anura3D MICINN - Generación de Conocimiento Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

PASMA - Principios y aplicaciones de la mecánica del suelo para anclaje de instalaciones marinas de energías renovables – MCIU – Retos Investigación Coordinator: CIMNE - *01/09/2021 - 31/08/2024*

REROOT - REalistic models or soil-ROOT mechanical interaction MICINN - Generación de Conocimiento Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

SiM - Soil in Motion – MCIU – Retos Investigación Coordinator: CIMNE - *01/01/2019 - 31/12/2022*

Staff

Marcos Arroyo (Leader)	Sebastià Olivella
	Núria M. Pinyol
Matías Alonso	Ivan Puig
Clara Alvarado	Anna Ramon
Ramón Barboza	Mohammad Razavi
Álvaro Boeiro	Alfonso Rodríguez
Alessandra Di Mariano	Enrique E. Romero
Diego E. Duran	Jatnna A. Sánchez
Alessandro Fraccica	Sebastián Sandoval
Antonio Gens	Núria Sau
Laura González	Babak Sayad
Maria Juliana Knobelsdorf	Fernando A. Sossa
Judith Landinez	Daniel Tarragó
Alberto Ledesma	Erdem Toprak
Arisleidy Mesa	Davood Yazdani
Aníbal A. Moncada	María Teresa Yubero
Luis Monforte	

Hydrogeology

The Hydrogeology Research Group conducts research and knowledge transfer to society in the fields of subsurface hydrology and bio-geochemistry. The Group works on the characterization of permeable media by hydraulic data, hydrochemical and environmental isotope. Applications include groundwater resources, aquifer management, saltwater intrusion, managed aquifer recharge, and transport of pathogenic microorganisms in the subsurface.

The methods span several scales, from the pore to regional aquifers, strongly based on quantitative methods, with the use of numerical modeling of flow and mass transport including bio catalyzed chemical reactions. Emphasis is placed on process understanding, based on experimental efforts at the laboratory and the field, leading to model conceptualization of complex phenomena in the field of Water Resources that need to be addressed by new computing.
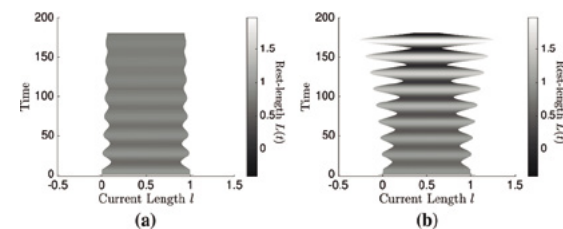
Figure from the paper "Stability bounds of a delay visco-elastic rheological model with substrate friction", by M. Dawi et al., Journal of Mathematical Biology, 2021.

Research

• Simulations of biofilm growth in porous media.
  PI: Xavier Sànchez-Vila

• Hydraulic test interpretation in heterogeneous aquifers. **PI: Xavier Sànchez-Vila**

• Interactions between civil Works and groundwater **PI: Daniel Fernandez**

Staff

Xavier Sànchez-Vila (Leader)
Marc Carnicero
Malik Dawi
Daniel Fernández
Alfonso Rodríguez

Machine Learning in Civil Engineering

The main objective of the group is to solve complex engineering problems by applying machine learning techniques with data obtained from sensors and numerical models. The main area of activity is the field of hydraulic works: dams, spillways, water supply networks, hydrology and water quality treatments. However, these same techniques have been applied in other fields such as the analysis of railway ballast, landslides or air quality forecasting.

The group has a strong background in the use of machine learning techniques in health monitoring of dams for anomaly detection and predictive maintenance. At present, it is developing methodologies for the efficient quantification of uncertainty in complex problems, combining machine learning and advanced numerical methods. The group has a clear practical approach, and includes among its capabilities the development of customized user interfaces.

New areas of application for machine learning techniques include water quality prediction and wastewater disinfection through advanced tertiary treatments, prediction of ozone concentration and optimization of manufacturing processes such as metal forming.

Research

Research activities involving Machine Learning techniques:

• Machine Learning (ML) for dam safety assessment: Development of methodologies and software for analysis of dam monitoring data, including generation of ML predictive models and their interpretation, with the final objective of supporting decision making in dam safety.
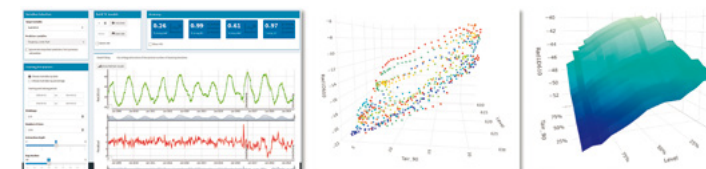

Software for dam safety assessment through ML: screenshots of PREDATOR/SOLDIER application

• New computational tools for reliability-based dam safety assessment: Use of ML models to support FEM analysis to predict dam response in ordinary and extreme scenarios.
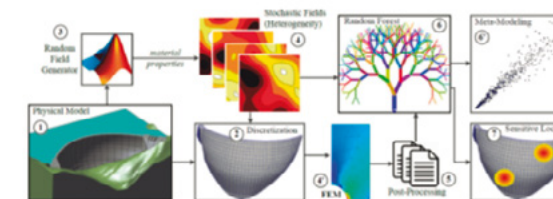

Anomaly detection in dams: example of monitoring network (left) and numerical model to simulate anomalous events (right)

• Evaluation of potential risk of off-stream reservoirs: Development of data-driven classification models for fast evaluation of damages due to failure of off-stream reservoirs.
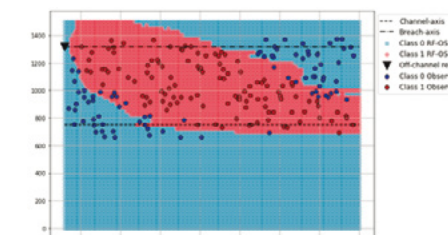
Results of ML model for predicting damages due to failure of off-stream reservoirs

• Short-term streamflow prediction: Combining synthetic (based on the physically-based model Iber) and measured data to produce prediction of hourly streamflow with machine learning models.
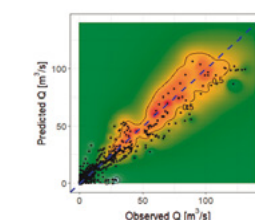
Results related to short-term streamflow prediction research

• **Water quality and water treatment techniques:** Application of ML models for the prediction of water quality status in water bodies and assessment of advanced water pollutant removal treatments.

• **Prediction of concentration of tropospheric ozone based on ML techniques:** Analysis of meteorological and air quality data; development of ML-based predictive models; Identification of the main variables influencing the occurrence of high ozone episodes.

Screenshot of "Piksel" platform – Challenge 3 for ozone concentration forecast

• **Smart optimization of industrial processes:** Support and optimization of rotational metal deformation design processes. Use of FEM-based Digital Twin framework combined with ML classification techniques.

• **Development of calibration utilities:** Calibration of Discrete Element Method (DEM) parameters combining high performance numerical calculation with ML.

Research activities involving Numerical Methods:

• **Thermo-mechanical behavior of concrete dams:** Simulation of concrete dam behavior during construction and operation stages integrating high-detailed thermo-mechanical loads.

• **Design of wedge shaped block spillways:** CFD simulation through Eulerian FEM modelling and block stability simulation through DEM modelling.

Fuse gates simulation: geometry design (left), fluid-solid interaction 2D simulation (center) and 3D simulation (right)

• **Industrial design of dam fuse gates:** Fluid-solid interaction simulations through PFEM+DEM modelling to calculate the following processes: discharge flow for different gate positions, gate falling velocity and gate-wall impact force.

On-going RTD Projects

ACROPOLIS - CIAsifiCación de balsas frente al RiesgO POtenciaL combinando GIS y Machine Learning
MCIU - Retos Colaboración
Coordinator: IDP - *01/07/2020 - 31/12/2022*

DIGIT4WATER – Development of digital tools based on Machine Learning models for the prediction of removal levels of different pollutants in advanced tertiary treatments
MCIU - Generación de Conocimiento
Coordinator: CIEMAT- *01/12/2022 - 30/11/2024*

DOLMEN – Control de la seguridad de presas con umbrales de aviso dinámicos combinando modelos numéricos y aprendizaje automático
MCIU - Generación de Conocimiento
Coordinator: CIMNE - *01/09/2022 - 31/08/2025*

OPTIPRO – Sistema inteligente de optimización de procesos de deformación de metal por rotación mediante simulación avanzada
MCIU - Retos Colaboración
Coordinator: Industrias Puigjaner, S.A - 01/07/2020 - 30/06/2023

OPTIREP – Millores tecnològiques per optimitzar els processos de conformat metàl·lic per repulsat
Acció - Nuclis d'R+D empresarial
Coordinator: CIMNE - *01/01/2023 - 31/12/2024*

TRISTAN - New computational Tools for Rellability-based dam SafeTy AssessmeNt
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 30/09/2022*

Staff
Fernando Salazar (Leader)

Joaquín Irazábal
Sergio R. López
Cristian Ponce

Nathalia Silva
David J. Vicente

River Dynamics and Hydrologic Engineering (Flumen Institute)

The FLUMEN Institute is the outcome of merging the FLUMEN RTD group existing since 2005 at the School of Civil Engineering of UPC - BarcelonaTech and CIMNE, bringing together the numerical and experimental expertise of FLUMEN RTD group in hydraulics with the broad experience of CIMNE on numerical methods, computer simulation and integration of decision support systems.

The objectives of FLUMEN are the promotion of RTD and technology transfer activities in the field of River Dynamics and Hydrologic Engineering.
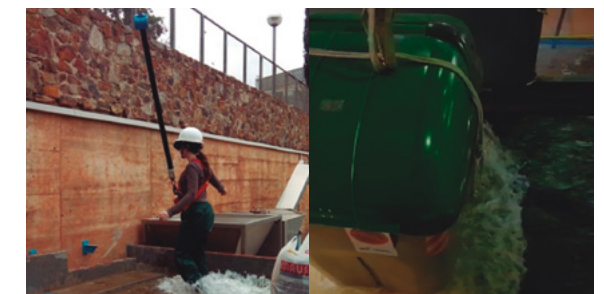
FLUMEN is an Academic Research Institute affiliated with the Technical University of Catalonia (UPC · BarcelonaTech) and CIMNE. FLUMEN was founded by the Government of Catalonia (Generalitat de Catalunya) through the order ECO/305/2012 on October 3rd (DOGC October 17th) and it is an interdisciplinary research group (SGR 1139).

The FLUMEN Institute is actively engaged in research activities, consulting, training and technology transfer in relation to hydrology and river dynamics. When first established in the 1980's the experience of the Flumen Research Group was incorporated.

These activities have been developed and perpetuated inside the framework provided by the School of Civil Engineering of Barcelona, and the Department of Civil and Environmental Engineering of UPC.

Research

• **River hydrodynamics:**
  • Settlements and land use concerning flood risks
  • Solid transport and river geomorphology
  • Transport of non reactive substances
  • River rehabilitation
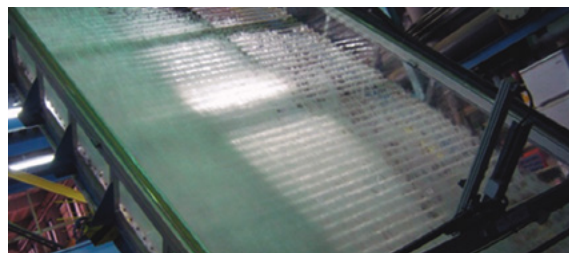 • Preservation and rehabilitation of wetlands

• **Urban hydrology:**

• Urban drainage: sewer network/surface runoff. Inlets
• Pollutant load in urban hydrology
• Flood risks in urban areas

- Thermal and hydrodynamic behaviour
- Sediment and nutrients dynamics
- Reservoir impact on river dynamics
- Corrective measures
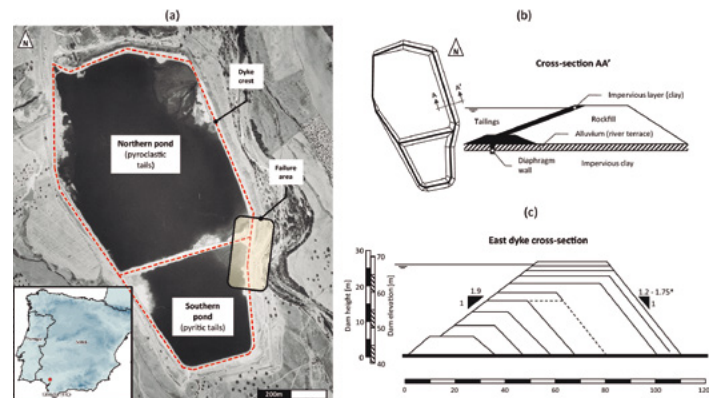
• Dam hydraulics:

- New designs for spill-flows
- Spills over crest

• Irrigation canals exploitation:

- Automatic control algorithms
- Control structure and lateral storage

Revisiting the Hydraulics of the Aznalcóllar Mine Disaster (M. Sanz et al., 2022)

• Flow-soil-structure interaction:
  - New numerical methods based on the integration particles technique with discrete element methods and finite elements
  - Stability and safety of structures under hydraulic influences (water)

On-going RTD Projects

ACROPOLIS - ClAsifiCación de balsas frente al RiesgO POtenciaL combinando GIS y Machine Learning
MICINN - Retos Colaboración
Coordinator: IDP - *01/07/2020 - 31/12/2022*

BCN-SOSTENIBLE - Avaluació de SUDS-lineals per reduir el risc d'inundació amb horitzons de Canvi Climàtic
Ajuntament de Barcelona - Economia Climàtica
Coordinator: CIMNE - *08/02/2021 - 07/02/2022*

PIPLATES –Plataforma de Predicció Territorial
GENCAT
Coordinator: CIMNE - *01/07/2021 - 31/12/2022*

Staff

Ernest Bladé (Leader)
Danial Dehgan Suraki
Gonzalo Olivares
Anaïs Ramos
Marcos Sanz

Structural Mechanics

The objective of the Structural Mechanics Group is the development of innovative numerical methods for analysis of structures of standard materials (metallic materials and concrete), as well as structures incorporating new materials such as composites and hybrid materials.

The numerical methods developed by the group include the finite element method (FEM) and a number of particle-based computational techniques, such as the discrete element method (DEM) and the particle finite element method (PFEM), among others.

Research

- **Particle Finite Element Method (PFEM)** for multidisciplinary coupled problems in engineering.
  PIs: A. Franci and E. Oñate
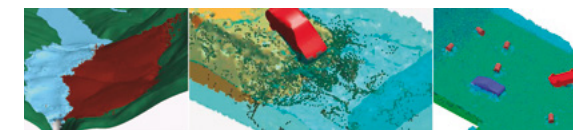
- **Finite element methods (FEM)** for nonlinear analysis of solids and structures with standard and composite materials.
  PIs: X Martinez, F. Rastellini and E. Oñate

- **Innovative interface elements** for modelling discontinuities in solids. **PI: I. de Pouplana**

- **Particle Finite Element Method (PFEM)** for multidisciplinary problems in solid mechanics.
 **PIs: J.M. Carbonell and E. Oñate**
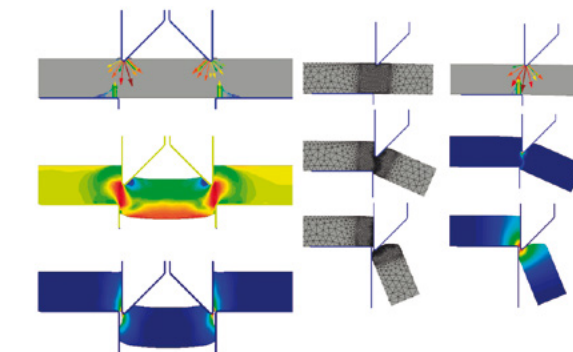
- **Discrete element methods (DEM)** for analysis of non-cohesive and cohesive materials.
  PIs: M.A. Celigueta and E. Oñate

- **Coupling** of DEM, FEM and PFEM procedures.
 **PIs: M.A. Celigueta, G. Casas and I. Pouplana**

- **Finite elements** for analysis of plates and shells.
  PIs: E. Oñate, F. Rastellini and J.M. González

- **FEM-DEM procedures** for analysis of multi-fracture problems in solids and structures.
  PIs: F. Zarate, A. Cornejo, J.M. Cornejo and E. Oñate
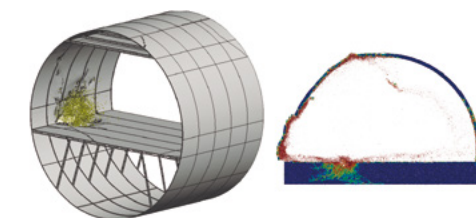
- **Innovative fatigue models accounting** for coupled damage and plasticity effects for analysis of structures under high, medium and low cycling loads with the FEM.
  PIs: S. Jimenez, L. Barbu and E. Oñate

- **Modelling and simulation** of the melting and burning of objects in fire.
 **PIs: J. Marti and E. Oñate**
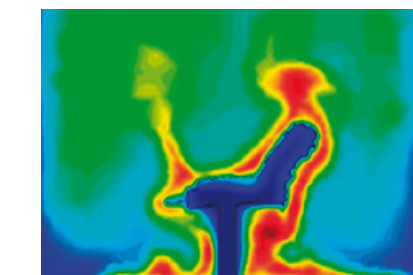
• **Particle-based methods for analysis of particulate flows.** Applications to the modelling and simulation of suspended particles in fluids.
PIs: S. Idelsohn, E. Oñate, J.M. Gimenez and G. Casas

• **Numerical methods for accurate and fast solution** of transient problems in continuum and structural mechanics using particle-based techniques and finite element procedures. Applications to problems in the oil and gas industry, environmental safety problems and industrial forming processes.
PIs: E. Oñate and I. de Pouplana
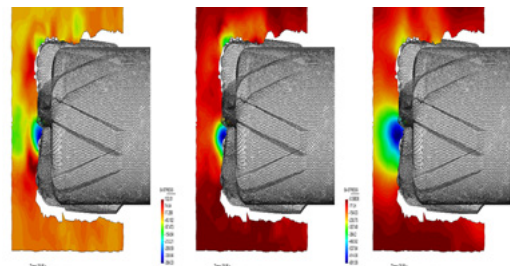
• **Numerical methods for analysis of the propagation of pollution in air flows.** Application to the study of propagation of NO2 emissions due to traffic in urban environments. **PIs: I de Pouplana and E.Oñate**

• **Fast explicit time integration schemes with large time steps.** Applications in transient heat conduction problems, Stokes flows and Lagrangian flows.
PI: E. Oñate

On-going RTD Projects

ADAPTA - Computational models for assessment and treatment aortic dissections: evaluation and design endovascular devices
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/09/2022 - 31/08/2025*

Add2Man - Design tool for optimal performance in Additive Manufacturing
AGAUR- Producte
Coordinator: CIMNE - *23/07/2020 - 22/01/2022*

ALTERNATE - Assessment on Alternative Aviation Fuels Development
EC - H2020 - SC4-Smart, green & integrated transport
Coordinator: UPM - *01/01/2020 - 31/12/2022*

AMADEUS - Advanced Multi-scAle moDEling of coupled mass transport for improving water management in fUel cellS
MCIU - Proyecto de Generación de Conocimiento
Coordinator: CIMNE - *01/01/2019 - 30/09/2022*

COMET-K1 -Modeling and simulation of laser-controlled process and manufacturing techniques (VII-2.06)
FFG - COMET
Coordinator: PCCL - *01/01/2021 - 31/12/2024*

DIDRO - Towards building of Digital Twins for manufacturing processes based on drop-on-demand printing
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

GRAIN - An innovative multi-scale data-driven paradigm for the modelling of granular flows
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/09/2022 -31/08/2025*

LIGHT3D - Tecnologies de Làser i altra Llum (BASE3D)
GENCAT - Activitats Emergents
Coordinator: Fundació CIM - *31/12/2019 -31/12/2022*

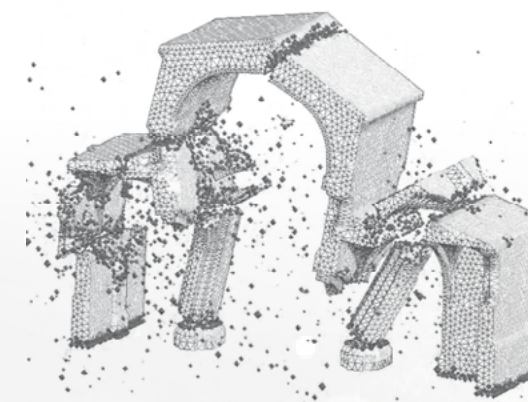**MATHEGRAM** - Multiscale analysis of thermomechanical behaviour of granular materials
EC - H2020 - Coordinator: USUR - UNIS
01/01/2019 - 30/06/2023

OPTIPRO - Sistema inteligente de optimización de procesos de deformación de metal por rotación mediante simulación avanzada
MCIU - Retos Colaboración - *01/07/2020 - 30/06/2023*

PARAFLUIDS - Un Método Numérico Multi-Escala para Fluidos con Partículas
MCIU - Retos Investigación - *01/06/2020 - 31/05/2023*
PECT InnoDelta - Projecte d'Especialització i Competitivitat Territorial InnoDelta: Territori laboratori per a la sostenibilitat ambiental, social i econòmica del teixit industrial
GENCAT - Instruments per a la especialització intel·ligent
Coordinator: Viladecans City Council
30/04/2021 - 31/12/2023

PIPLATES - Plataforma de Predicció Territorial
GENCAT - Tecnologies Digitals Avançades (TDA)
Coordinator: CIMNE - *01/01/2021 - 30/12/2022*

REROOT - REalistic models or soil-ROOT mechanical interaction
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

SECCO2 - Software libre para la digitalización del proceso de secuestro de CO2
MICINN -Generación de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

TRISTAN - New computational Tools for RelIability-based dam SafeTy AssessmeNt
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 31/09/2022*

Staff

Eugenio Oñate (Leader)

Diego Aguilera	Sergio Idelsohn
Hadi Bakhshan	Sergio Jiménez
Gabriel Bugeda	Juan Salvador Latorre
Josep Maria Carbonell	Julio M. Martí
Guillermo Casas	Javier Mora
Karen Casallas	Rafael Nazareth
Miguel Ángel Celigueta	Junior Ramírez
Ignasi de Pouplana	Fernando Rastellini
Daniel Di Capua	Ramon Ribó
Maria Montserrat Dolz	Pavel Ryzhakov
Roberto M. Flores	Aniol Sala
Alessandro Franci	Omar Salomón
Óscar Fruitós	Chengshun Shang
Juan Marcelo Giménez	Laurence Sigler
Juan Sebastián Gómez	Francesc Turón
Joaquín González	Pere Andreu Ubach
José Manuel González	Ignacio Valero
Mohammad R. Hashemi	Francisco Zárate
Fernando Hermosilla	Massimiliano Zecchetto

Composites and Advanced Materials for Multifunctional Structures

The main objective of the Composites and Advanced Materials for Multifunctional Structures (CAMMS) group at CIMNE is to develop numerical methods and procedures for the prediction and characterization of the performance of such materials, and to use these methods in the analysis of large multifunctional structures.
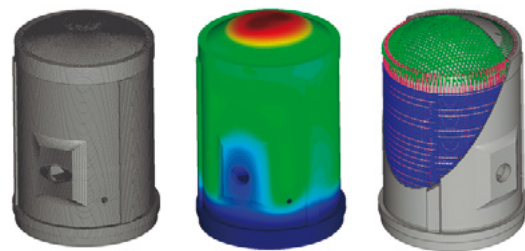
Geometry and Finite Element mesh of a nuclear containment building. See the steel tendons distributed within the structure

Research

• Numerical Strategies for the analysis of Composites Materials
Composites and Advanced Materials are understood as all materials with improved properties, requiring of specific formulations for their correct analysis and characterization. Among those, the group has a large tradition on the development of numerical strategies for the analysis of composite materials made of fibres embedded in a matrix system, ranging from an improved version of the mixing theory, to more advanced multiscale procedures.

• Additional research lines:
  • Constitutive laws for the analysis of plasticity and damage
  • Models for the analysis of fibre-metal laminates
  • Reinforced and prestressed concrete
  • Topological optimized materials
  • Fatigue

• Integration with FE Codes
The final objective of all advanced materials models developed is the analysis of large structures and multifunctional structures.

Staff

Xavier Martínez (Leader)

Bárbara Alcayde	Sergi Ocon
Lucia Barbu	Fermin Otero
Alejandro Cornejo	Raúl Rubio
Montserrat Dolz	Pablo Sierra
Luis Antônio Gonçalves	Alireza Taherzadeh
Alex Ferrer	Jose Torres
Sergio Jiménez	Francesc Turon
Lluís Martorell	

On-going RTD Projects

Fatigue4Light - Fatigue modelling and fast testing methodologies to optimize part design and to boost lightweight materials deployment in chassis parts
H2020 - SC4-Smart, green & integrated transport
Coordinator: CIMNE - *01/02/2021 - 31/01/2024*

FIBRE4YARDS - FIBRE composite manufacturing technologies FOR the automation and modular construction in shipYARDS
EC- H2020 - SC4-Smart, green & integrated transport
Coordinator: CIMNE - *01/01/2021 - 31/12/2023*

FIBREGY - Development, engineering, production and life-cycle management of improved FIBRE-based material solutions
H2020 - Leadership in enabling & industrial technologies
Coordinator: CIMNE - *01/01/2021 - 31/12/2023*

GRAIN - An innovative multi-scale data-driven paradigm for the modelling of granular flows
MICINN - Generación de Conocimiento
Coordinator: CIMNE
01/09/2022 -31/08/2025

Subdomain deformation modes of an omega pultruded beam obtained with the ROM
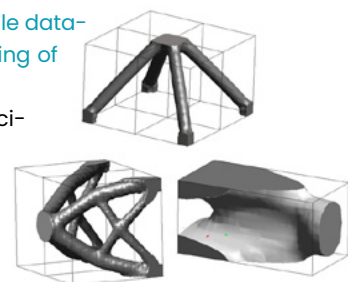
Shape and topology algorithms implemented for generative design of materials and structures

# Computational Design & Analysis of Engineering Metamaterials

The mission of the Computational Design & Analysis of Engineering Metamaterials group is the development of new computational tools for designing metamaterials with extreme acoustic, mechanical and electro-magnetic properties, focusing engineering applications.

Research

• Computational Design of Engineering Metamaterials. Development of new acoustic meta-materials (panels) for customized acoustic insulation.
Applications: high-performance acoustic insulation of buildings and transport vehicles.
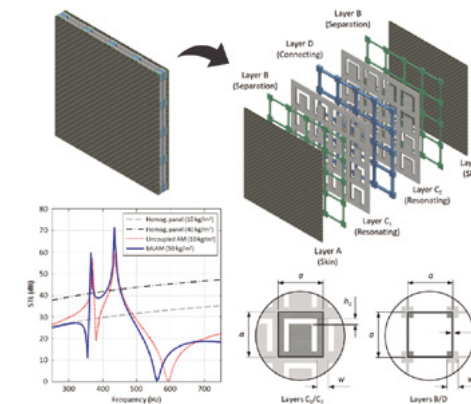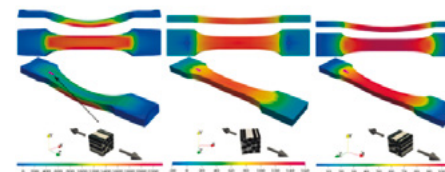

• Computational topology optimization of materials. Development of methods for topology optimization in structural and thermal problems using variational-based techniques.
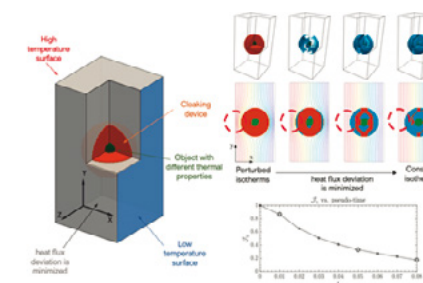
• Development of new metamaterials for Wireless Power Transfer (WPT)
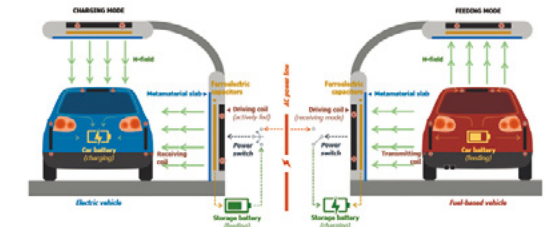
• High Performance Model Order Reduction methods (HPR-FE2) for industrial multiscale material modelling and design.

• Development of shock-absorbing metamaterials. Design and analysis of efficient shock absorbing metamaterials.

• Efficient methods for computational design of high-performance composite laminates

Staff

Xavier Oliver (Leader)

Juan Carlos Cante	David Roca
Oriol Lloberas-Valls	Gastón Sal-Anglada
Álex Núñez	Pablo Wierna
	Daniel Yago

On-going RTD Projects

AC-METATECH-DES - Noise mitigation via acoustic metamaterial technology: computational design and prototyping solutions
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/12/2022 -30/11/2024*

METACOUSTECH Demonstration of acoustic metamaterial-based technology for soundproofing applications
AGAUR -PRODUCTE 2021
Coordinator: CIMNE - *19/10/2022 - 18/04/2024*

Mechanics of Electroactive Materials

This group will develop theoretical and computational models to quantify flexoelectricity in solids, focusing on continuum models but also exploring multiscale aspects, in tight collaboration with experiments.

The research group explores the effects of strain gradients on the physics of dielectrics, identifying fundamental manifestations and identifying the underlying engineering principles for a new generation of electromechanical metamaterials.

Research

• **Theoretical framework of flexoelectricity.** A comprehensive theoretical framework for flexoelectricity in infinitesimal and finite deformation, establishing the precise connections between the different families of formulations, their physical interpretation and the physical meaning of the corresponding set of high-order boundary conditions. **PIs: D. Codony, H. Mohammadi and I. Arias**

• **Efficient numerical solution of high-order general electromechanics problems:** Advanced discretization methods, including immersed B-splines and C0 penalty, for the efficient solution of the 4th-order PDE system arising in flexoelectricity in general geometries, material and electrode configurations. **PIs: D. Codony, S. Fernández and Irene Arias**
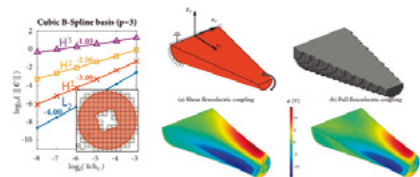
• **Reduced theories of flexoelectric beams and shells:** Reduced theories for non-linear flexoelectric beams and non-linear shells to gain understanding of the physics and aid the design of new devices. **PIs: P. Gupta, D. Millán and I. Arias**

• **Flexoelectricity from first principles:** Electronic structure calculations of flexoelectric systems to establish a precise connection with continuum models both guiding the development of enriched models accounting for nanoscale effects and finite surface effects and characterizing continuum model parameters. **PIs: D. Codony, M. Dingle, I. Arias in collaboration with P. Suryanarayana**

• **Fundamental manifestation of flexoelectricity in torsion mechanics:** Development of new methods to mobilize flexoelectricity under torsion to provide understanding about the fundamental physics and flexoelectricity characterization tools. **PIs: Irene Arias and A. Mocci**

• **Fundamental manifestation of flexoelectricity in strain and electric field singularities:** cracks, ferroelectric domain walls, creasing, AFM: Exploration of the physics of flexoelectricity in situations where large strain or electric field gradients develop. **PIs: H. Mohammadi, I. Arias and external collaborators (G. Catalan, N. Domingo, ICN2, P. Paruch, U. Geneva, S. Hong, KAIST).**

• **Design and characterization of flexoelectric devices and metamaterials:** New concepts for the design of effectively piezoelectric metamaterials and devices from non-piezoelectric components. **PIs: Irene Arias, A. Mocci, D. Codony, P. Gupta and F. Grecco**

• **Theoretical and computational modeling of flexo-photovoltaics:** Development of a theoretical and computational framework for the simulation of flexo-photovoltaics aiming at the design and optimization of a new family of solar-cells. **PIs: Irene Arias, D. Codony and S. Fernández**

Staff

**Irene Arias (Leader)**
Sonia Fernández
Hossein Mohammadi

# Soft and Living Material Interfaces

The group develops theoretical and computational models for the mechanobiology biological interfaces, cells and tissues, with the goal of quantitatively understanding these systems, rationally manipulating active living materials and engineering new bionic materials.

Research

• **Mechanisms of collective invasion in breast cancer organoids:** In tight collaboration with Group Khalil (UMC Utrecht), identification of the mechanisms leading to collective invasion in the context of invasive ductal carcinoma, specifically the two-way interplay between cellular activity and collagen matrix chemo-mechanics. **PI: Marino Arroyo**
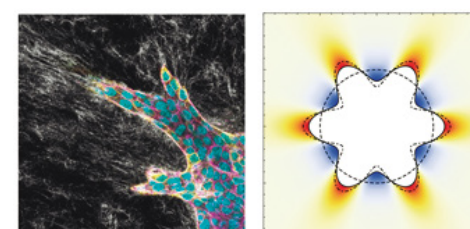
• **Mechanics of Epithelial materials:** Development of theoretical and computational models to understand and rationally manipulate epithelial materials in-vivo and in bio-hybrid devices. **PI: Marino Arroyo**
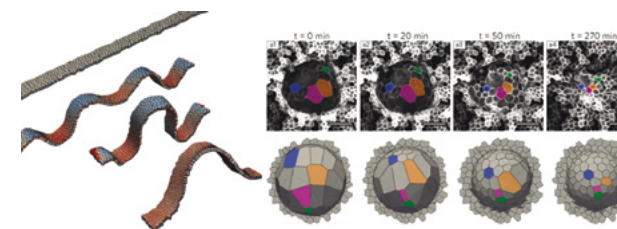
• **Mechanics of the cell envelope:** Development of theoretical and computational models to understand and quantify the mechanics of the cell envelope, and to develop biomimetic multifunctional systems based on the engineering principles of the cell envelope. **PI: Marino Arroyo**

• **Motility of cells and of artificial bio-inspired systems:** Development of theoretical and computational models to understand cell motility and to understand and conceive mechanisms for bio-inspired motile artificial systems. **PI: Marino Arroyo**
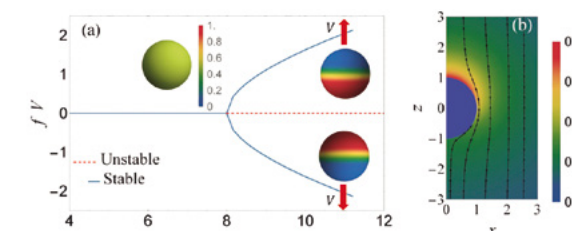
• **Analysis of cell and tissue dynamics:** Modelling of regulation of cell contractility and intercalation during morphogenesis. Development of specific finite element and vertex models. **PI: José Muñoz.**
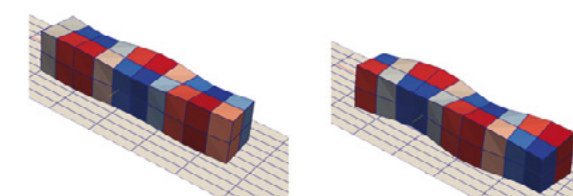
• **Control and optimisation in organism locomotion:** design of optimisation and control numerical algorithms for understanding locomotion patterns of microorganism. **PI: José Muñoz**
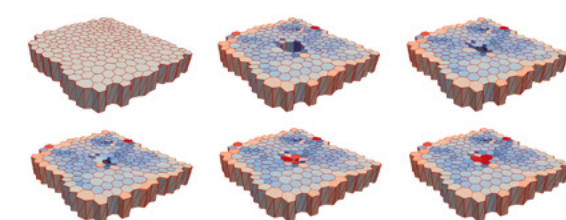
Staff

Marino Arroyo (Leader)
Pau Blanco
Ashutosh Bijalwan
Jose Muñoz

Bio-Medical Engineering

The main objective of the group is to solve complex biomedical engineering problems by applying numerical models, machine learning techniques and virtual and augmented reality models.

The Biomedical Engineering (BME) group of CIMNE offers software solutions to automatically transform medical imaging to create a 3D digital twins of the patients to help diagnostics, to virtually try treatments, and to automatically design optimal braces and devices.

One of the main areas of activity of the BME group is the field of personalized cardiovascular devices. For medical companies and physicians who need to improve their personalized designs, BME brings innovative tools based on our numerical simulation technology to better design cardiovascular medical devices during the pre-prototype stage. The BME group aims at making patient care more personalized and secured.
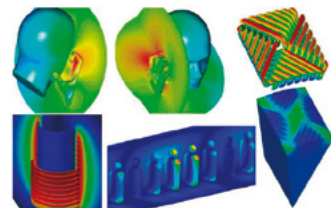
Research

- **Cardiovascular Research:**
  Methods to simulate blood flow simulation for different cardiovascular pathologies as Abdominal Aneurysm, Aorta coarctation and dissection, etc. Full scale cardiovascular models: 0D-1D-3D. **PI: E.Soudah.**
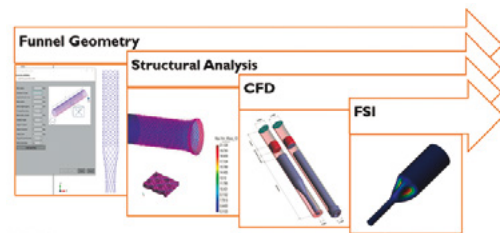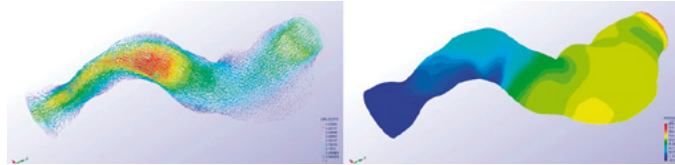

- **Electromagnetics in Health:**
  Numerical simulations model to study the effect of the electromagnetic field inside humans.


- **Artificial Intelligence Methods:** Combination of numerical simulations with machine learning techniques for different pathologies.
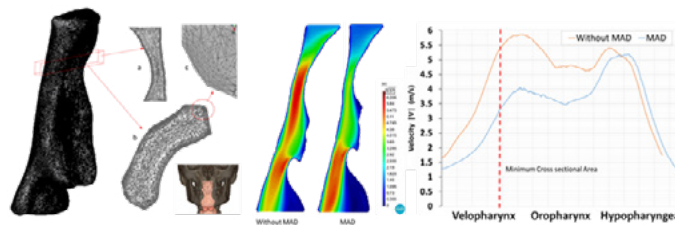

- **Medical Device R&D:** Medical devices for medical companies and physicians to improve their personalized designs. Innovative tools based on our numerical simulation technology to better design medical devices during the pre-prototype stage. **PIs: E. Soudah and J. A. Hernández.**
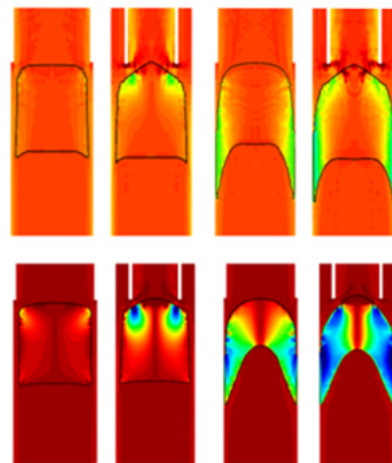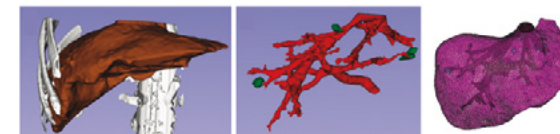

- **Respiratory System:** New solution for Obstructive Sleep Apnea treatment (OSAS). **PI: E. Soudah.**

- **Image Processing & Modelling:** Software solutions to automatically transform medical imaging to create a 3D digital models to help diagnostics, to virtually try treatments, and to automatically design optimal devices. **PI: E. Soudah.**

- **BIM & TIC Applications:** Mobile applications and virtual scenarios for teaching and training anatomy, anesthesia and cardiovascular pathologies for medical/resident students and continuous training of the healthcare system. BIM environment for hospitals. **PI: E. Soudah.**
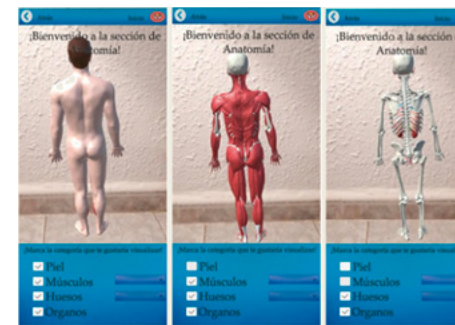
- **Augmented and Virtual Reality:** Interactive surgical communication platform based on augmented reality technology for clinical remote assistance in real time. **PI: E. Soudah.**

On-going RTD Projects

ADAPTA. Computational models for assessment and treatment Aortic dissections: evaluation and design endovascular devices
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/09/2022 - 31/08/2025*

NEXTGEM: Next Generation Integrated Sensing and Analytical System for Monitoring and Assessing Radiofrequency Electromagnetic Field Exposure and Health.
EC- HE (2021-2027)
Coordinator: FORTH - *01/07/2022 - 30/06/2026*

SIMUPATCH. Safety and efficacy validation of a medical device to treat aortic dissection using in silico and in vitro tools
MICINN - Transferencia de Conocimiento
Coordinator: CIMNE - *01/09/2022 - 31/08/2025*

Staff

Eduardo Soudah (Leader)
Óscar de Coss
Agustina Giuliodori
Joaquín A. Hernández
Rubén Otín
Alberto Tena
Rubén Zorrilla

Fluid Mechanics

The Fluid Mechanics Group focuses on the development of mathematical models and numerical methods for the solution of a wide range of problems in engineering and other applied sciences involving external and internal flows.

Applications include, among others, high speed compressible flows, turbulent flows, shallow water flows, flow in porous media, aero-acoustics, wave propagation, viscoelastic fluids, bio-flows and many multidisciplinary coupled problems involving fluids, such as magneto-hydro-dynamics, fluid-structure interaction, and thermal flows.

Research

- **Stabilized finite element methods for problems** involving waves, viscoelastic flows, compressible flows, shallow water flows, magneto-hydro-dynamics, approximation of eigenvalues, finite strain solid dynamics and structural elements. **PI: R. Codina**

- **Efficient time integration schemes**, including algebraic fractional step schemes for incompressible flows, adaptive time integration schemes and accuracy enhancement using artificial neural networks. **PI: R. Codina**
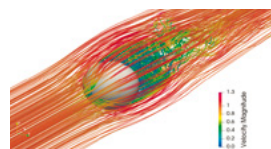
- **Reduced order models in fluid mechanics (ROM).** Development of POD and adaptivity/Artificial-Neural-Network based reduced order models, with special emphasis on stabilization issues. **PIs: R. Codina and S. Idelsohn**
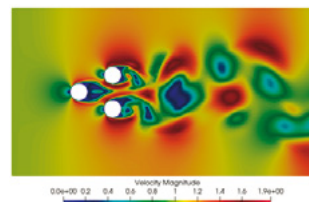
- **Acoustic analogies in incompressible flows.** Direct numerical simulation of sound, aero-acoustics in time dependent domains. Simulation of railway generated sound. **PIs: R. Codina and J. Baiges**

- **Topology optimization in fluid-structure interaction.** Finite strain cases which require a special treatment, and incompressible and nearly incompressible materials. **PIs: R. Codina and J. Baiges**

- **Numerical simulation of Additive manufacturing processes.** H-adaptive methodologies, high performance computing and large scale parallelization. Application to metallic materials, plastics and concrete. **PI: J. Baiges**

On-going projects

ePLANET European Public Local Authorities' Network for driving the Energy Transition
EC - H2020 - SC3
CIMNE - *01/09/2021 - 31/08/2024*

SSeCoID - Stability and Sensitivity Methods for Flow Control and Industrial Design
EC - H2020 - MSCA-Marie Sklodowska-Curie actions
Coordinator: UPM - *01/01/2021 - 31/12/2024*

TOP-FSI - Topology Optimization of structures subject to fluid structure interaction
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 31/09/2022*

TOPFSI-APP - Desarrollo de un programa de software comercial utilizable a nivel industrial para la optimización topológica de estructuras sujetas a interacción fluido-estructura
MICINN - Transferencia de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

Staff

Ramon Codina **(Leader)**	Sheraz Ahmed Khan
Joan Baiges	Ignacio Martínez
Zulkeefal Dar	Saman Rahmani
Arnau Fabra	
Hauke Gravenkamp	
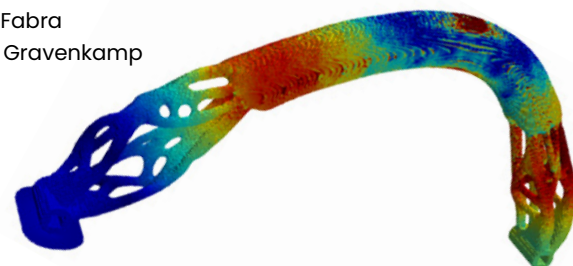
Industrial Manufacturing Processes

Since 1998, the Industrial Manufacturing Processes Group develops computational tools for thermo-mechanical modeling and advanced non-linear analysis tools.

The outcomes are generally implemented in COMET, a Finite Element based framework for the solution of engineering problems in both academic and industrial environments.
Multiple software modules of COMET have been successfully commercialized in Spain and worldwide for different industrial applications:
- Casting analysis: VULCAN
- Mold filling: CLICK2CAST
- Welding: WELDPACK
- Additive Manufacturing: ADD2MAN
- Sheet metal forming: STAMPACK

Research

PIs: M.Cervera and M. Chiumenti

- **Advanced Manufacturing Processes:** Additive Manufacturing, Friction Stir Welding, Electron Beam Welding, Shaped Metal Deposition, Casting processes and Metal Forming.

- **Constitutive Modeling and Computational Failure Mechanics.** New constitutive models appropriate for mechanical and civil engineering materials.

On-going projects

Add2Man - Design tool for optimal performance in Additive Manufacturing
EC - AGAUR - Producte
Coordinator: CIMNE
23/07/2020 - 22/01/2022
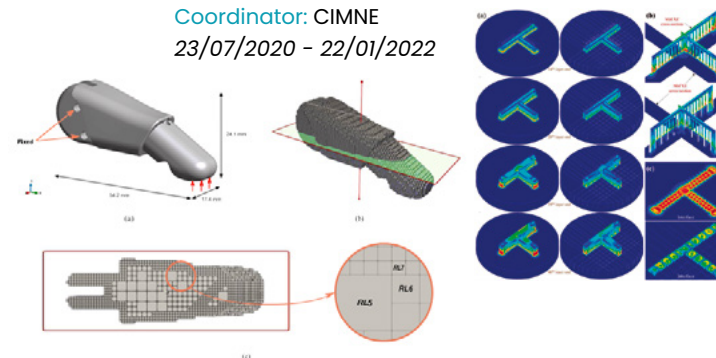
KYKLOS 4.0 - An Advanced Circular and Agile Manufacturing Ecosystem based on rapid reconfigurable manufacturing process and individualized consumer preferences - EC - H2020 - Coordinator: TECNALIA
01/01/2020 - 31/12/2023

LIGHT3D - Tecnologies de Làser i altra Llum (BASE3D)
GENCAT - Agrupacions en tecnologies emergents 2018
Coordinator: Fundació CIM
31/12/2019 - 31/12/2022

RESILMOB - Sistema Predictiu per una Mobilitat Resilient
GENCAT - ACCIÓ
Coordinator: PIGRA - *01/01/2023 - 31/12/2024*

OPTIPRO - Optimización inteligente de procesos de deformación de metal por rotación mediante simulación avanzada
MCIU - Retos Colaboración
Coordinator: Industrias Puigjaner, SA
01/07/2020 - 30/06/2023

SSeCoID - Stability and Sensitivity Methods for Flow Control and Industrial Design
EC - H2020 - MSCA-Marie Sklodowska-Curie actions
Coordinator: UPM - *01/01/2021 - 31/12/2024*

TOP-FSI - Topology Optimization of structures subject to fluid structure interaction
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 31/09/2022*

TOPFSI-APP - Software de optimización topológica de estructuras sujetas a interacción fluido-estructura
MICINN - Transferencia de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

Staff

Miguel Cervera (Leader)	Óscar Fruitós
Michele Chiumenti (Leader)	Carlos A. Moreira
Carlos Agelet de Saracibar	Iván Rivet
Gabriel Barbat	Mehdi Slimani
Manuel Caicedo	Henning Venghaus
Narges Dialami	Lu Xufei

Data-Driven High-Fidelity Modeling

In daily industrial practice, Computational Engineering faces two critical issues: efficiency and credibility. Indeed, efficient strategies are needed to carry out computationally-demanding multiple queries of complex multi-physics and multi-disciplinary problems arising in parametric studies. Besides, the output of the model is expected to be credible, namely with guaranteed numerical accuracy and quantified and controlled uncertainty. In a data-driven approach, data is used to update the model and quantify uncertainty.

The group responds to these challenges adopting a comprehensive approach in the discipline of computational science and engineering, developing new mathematical models and numerical methods to produce high-fidelity solutions in a variety of complex interdisciplinary problems.

The group is also active in the development of open-source software and in the integration of innovative algorithms in existing open-source libraries.

Research

• **Credible computational modeling & Uncertainty Quantification.** Development of numerical tools to assess and control credibility. This embraces four underlying ideas: control the numerical accuracy (Verification), enhance the quality of the approximation (Adaptivity), monitor the pertinence of the model (Validation) and account for the aleatoric nature of the systems analyzed (Uncertainty Quantification).

• **Data-driven model-updating.** Data assimilation strategies incorporate into models data from sensors, observations, and also from other models. This is complementary to Validation (via parameter identification) and strongly related with Uncertainty Quantification. This line includes developing novel Bayesian-based Markov chain Monte Carlo approaches.
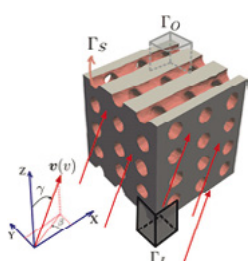
• **Reduced order models.** Intrusive and nonintrusive Reduced Order Models, using different numerical strategies accompanied by error control.

• **Robust solvers for computational science and engineering.** Simulation tools, insensitive to mesh quality, tailored to specific physical problems of industrial interest.

• **Multi-fidelity surrogates for parametric studies.** Detailed simulations of complex phenomena are often unaffordable due to their computational cost. At the same time, simplified models are usually not sufficiently accurate to achieve the precision required by physicists and engineers. In order to make real-time solution of parametric problems affordable, this line constructs and blends a hierarchy of simulations of different fidelities, bridging robust solvers with high-fidelity discretizations and reduced order models.

On-going RTD Projects

ProTechTion - Industrial decision-making on complex production technologies supported by simulation-based engineering
EC - MSCA - Marie Sklodowska - Curie actions
Coordinator: CIMNE - *01/03/2018 - 28/02/2022*
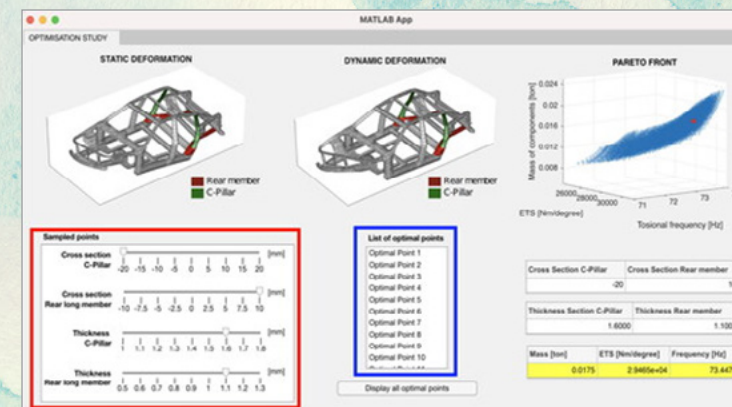
SMiLE - Machine Learning for data-driven modeling
MCIU- Retos Investigación
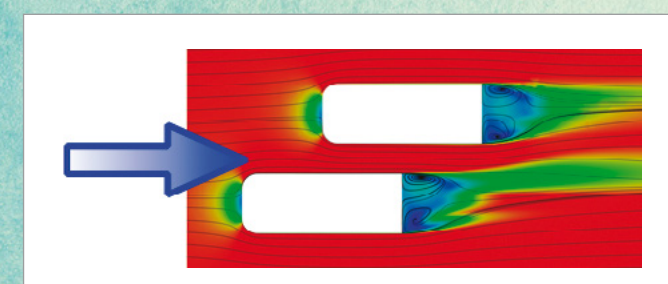Coordinator: UNIZAR - *01/09/2021 - 31/08/2024*

Staff

Pedro Díez (Leader)

Antonio Huerta	Álvaro Borrás
Sergio Zlotnik	Mariano Fernández
Alberto García-González	Stephan Gahima
Matteo Giacomini	Nadeem Kever
Alba Muixí	Rafel Perelló
Guillem Barroso	Luan M. Vieira

Reduced order models
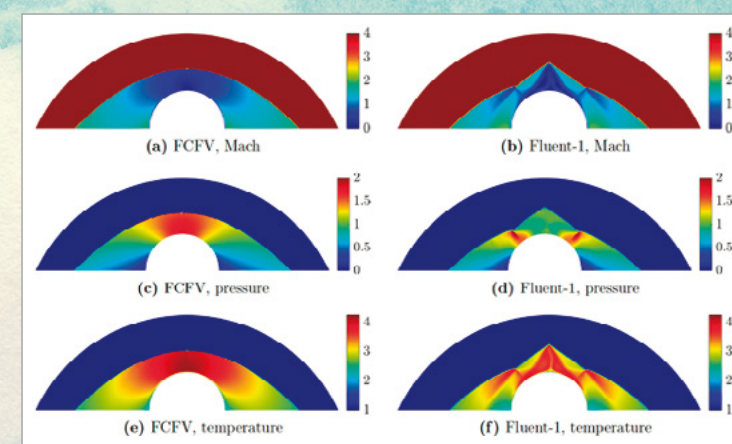
Robust solvers for computational science and engineering

Multi-fidelity surrogates for parametric studies
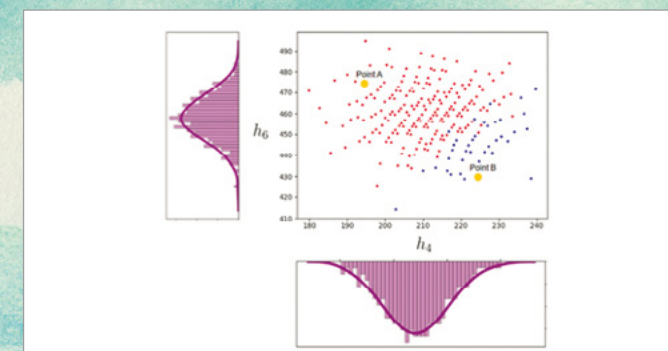
Credible computational modeling & Uncertainty Quantification

Kratos Multiphysics

The Kratos Multiphysics group aims at the development of a global purpose research code integrating state-of-the art capabilities in multiple fields, with the explicit goal of allowing the simulation of complex multiphysics problems.

The group aims at the exploitation of High Performance Computing (HPC) capabilities to be employed for the simulation of realistic engineering problems. This goal will be achieved both by the development of new solution technologies and by exploring the integration of models from different areas, thus making the research intrinsically transversal.

The research will foster open source developments and the collaboration with groups located in different places and working in different areas. It will also contribute to the integration of different technologies within a single, unified, workflow with the goal of enriching the solution capabilities of the Kratos framework.

Research

• Development of CFD models and other FEM technologies, including model order Reduction


CFD Simulation of a Motor

Kratos is continuously developing its solver capabilities to better serve projects. This includes the expansion and optimization of existing solvers for levelset-based computational fluid dynamics (CFD) and fluid-structure interaction (FSI) problems featuring two-phase flows.

• Development of Simulation Based Digital Twins

The group is actively exploring the combination of Hyperreduced-order models (HROMs) and HPC in order to significantly enhance the development and deployment of digital twins.

Hyper Reduction (HROM) Results
Left: Active simulated elements, Right: Result projection.
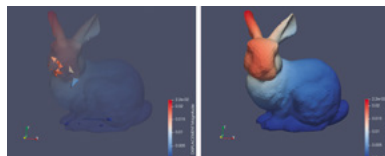
• HPC Workflows for constructing ROMs

The construction of reduced-order models (ROMs) entails a computationally intensive offline process that has been attacked by means of recourse to high-performance computing. The parallel workflow using Kratos Multiphysics and the COMPSs parallelization framework by the Barcelona Supercomputing Center performs the following tasks: a) Model creation; b) High-fidelity simulation; c) Reduction techniques; d) Feedback and refinement.

On-going projects

AMADEUS - Advanced Multi-scAle moDEling of coupled mass transport for improving water management in fUel cellS
MCIU - Proyectos de I+D: Generación de Conocimiento
Coordinator: CIMNE - *01/01/2019 - 30/09/2022*

DIDRO - Digital Twins for manufacturing processes based on drop-on-demand printing
MICINN - Generación de Conocimiento
Coordinator: CIMNE - *01/12/2022 - 30/11/2024*

eFlows4HPC - Enabling dynamic and Intelligent workflows in the future EuroHPCecosystem
EC-H2020 - Coordinator: BSC
01/01/2021 - 29/02/2024

NextSim - CODA: Next generation of industrial aerodynamic simulation code
EC-H2020 - Coordinator: BSC - *01/03/2021 - 29/02/2024*

Staff

Riccardo Rossi (Leader)

Sebastián Ares de Parga	Marc Núñez
Mohammad Azizpooryan	Joaquín H. Ortega
Raúl Bravo	Carlos Roig
Uxue Chasco	Pavel Ryzhakov
Alejandro Cornejo	Rubén Zorrilla
Mohammad R. Hashemi	Marco Zúñiga Pérez
Christian Narváez Muñoz	

Large-scale Scientific Computing

The large scale scientific computing group develops advanced numerical methods for the simulation of problems governed by PDES, e.g., solid and fluid mechanics and electromagnetics, together with the design and implementation of scalable solvers for the arising linear systems.

Research

• Uncertainty quantification. Development and analysis of multilevel Monte Carlo methods for stochastic partial differential equations, discretisation of PDEs on stochastic domains.
PIs: J. Hampton and J. Principe

• Unfitted finite element methods: Design of robust finite element schemes on embedded meshes, adaptive embedded methods on tree meshes, applications to moving geometries and interfaces.
PIs: S. Badia, E. Miranda and F. Verdugo

• Advanced geometrical discretisations: Design of robust and general geometrical discretization tools for embedded/unfitted approximation. One of the main objectives of this research is to develop numerical quadratures that exactly captured complex geometries for this kind of schemes.
**PI: S. Badia**

• Open source scientific software: Design of advanced mathematical software, e.g., using novel programming languages and programming paradigms, scalable implementations on distributed memory machines.
PIs: S. Badia and F. Verdugo

• Numerical methods for fusion technology: Development of advanced discretization methods for the numerical solution of magnetohydrodynamic problems with application to the design of breeding blankets in fusion reactors.
PIs: S. Badia
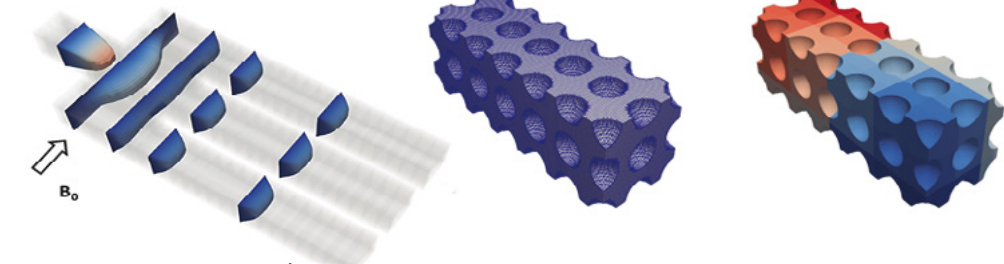
On-going RTD Projects

EUROFUSION - Implementation of activities described in the Roadmap to Fusion during Horizon 2020 through a Joint programme of the members of the EUROfusion consortium
EC - HE (2021-2027)
Coordinator: MPG - *01/01/2021 - 31/12/2024*

AMBBOS - Advanced computational Mathematics for Breeding Blanket Optimal deSign
MICINN - Generación de Conocimiento
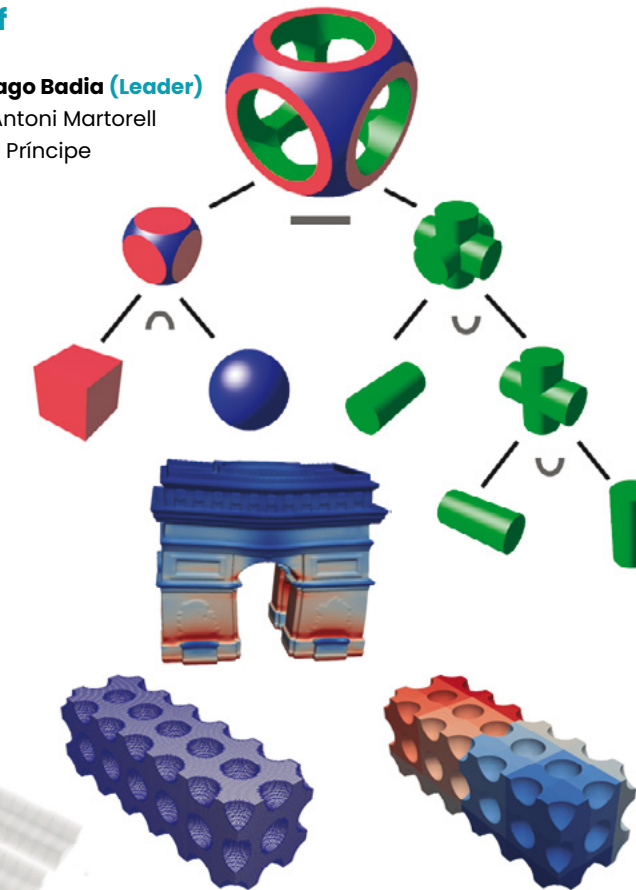Coordinator: CIMNE - *01/09/2022 - 31/08/2025*

SOFAST - Marco de optimización estocástica para el diseño estructural de aeronaves A Stochastic Optimization Framework for Aircraft STructural design
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 30/06/2022*

Staff

Santiago Badia (Leader)
Pere Antoni Martorell
Javier Príncipe

Aeronautics

The Aeronautics group develops new and challenging projects in the aeronautical field, optimization and data modelling, as well as fuel cells.

The group deals with research in computational fluid dynamics, fluid structure interaction with Particle Finite Element Methods and thin membrane structures, optimization and machine learning, and fuel cells technology and also collaborates with other CIMNE groups in Composites materials analysis or IT technology applied to sensoring and data management.

Research

- **FEM and meshless methods for aerodynamics analysis and drag reduction in aeronautics.** This research line is oriented to develop, implement and apply meshless methods in aeronautical and engineering applications. **PIs: J. Pons-Prats and E. Ortega**

- **Fluid-Structure Interaction and aeroelastic problems.** This research line is intended to develop methods for FSI problems in aeronautical and civil engineering. Emphasis is placed on fast (low-fidelity/surrogate) solution methods suitable for practical applications. **PIs: E. Ortega, R. Flores and J. Pons-Prats**

- **Optimization algorithms for robust optimal design, shape optimization and material design in aeronautics.** This research line is oriented to develop, implement and apply meshless methods in aeronautical and engineering applications. **PIs: G. Bugeda and J. Pons-Prats**

- **Future Mobility and future airport.** This research line focuses on future mobility paradigms, like Urban Air Mobility for passenger transport, and the effects on the design of airports. **PIs: J. Pons-Prats**
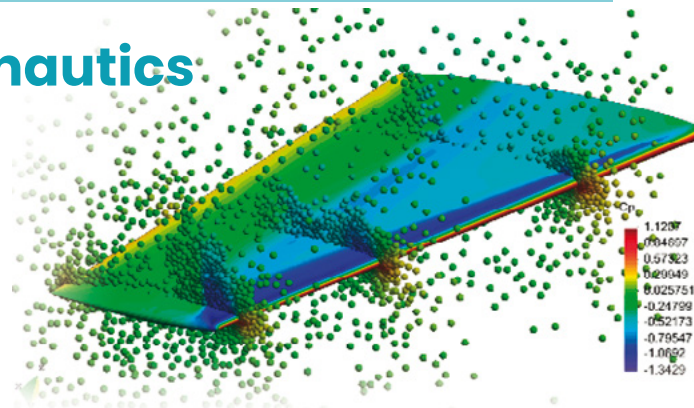
On-going RTD Projects

ALTERNATE - Assessment on Alternative Aviation Fuels Development
EC- H2020 - SC4-Smart, green & integrated transport
Coordinator: UPM - *01/01/2020 - 31/12/2022*

GAVIUS - Gavius: from reactive to proactive public administrations
EC - 4th Call for Proposals (2019)
Coordinator: Ajuntament de Gavà
01/09/2019 - 28/02/2023

NextSim - CODA: Next generation of industrial aerodynamic simulation code
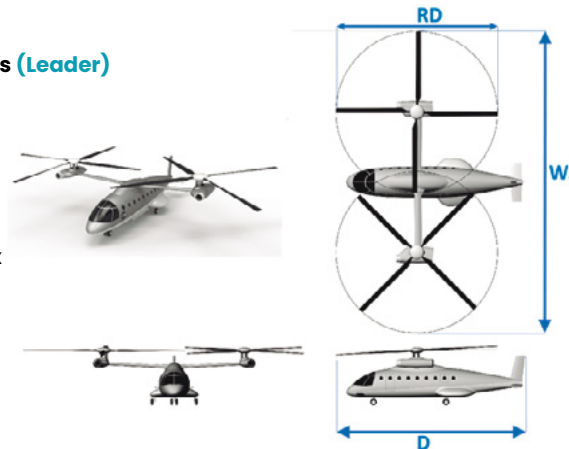EC-H2020 - Coordinator: BSC
01/03/2021 - 29/02/2024

SSeCoID - Stability and Sensitivity Methods for Flow Control and Industrial Design
EC-H2020 - Coordinator: UPM
01/01/2021 - 31/12/2024

Staff

Jordi Pons-Prats (Leader)
Gabriel Bugeda
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CENIT- Innovation in Multimodal Transport

CENIT's main activity is the knowledge generation related to transport, from logistics and mobility, to its transmission to society through research, training and technology transfer.

Since 2001, CENIT has carried out a large number of research projects, development and technology transfer projects in different areas of transport economics and engineering. The main goal has always been trying to focus on the social agents demand in specific areas. Especially in urban environment, enhancing the comfort of its inhabitants, providing more efficient transportation, and respect the environment. Investing in new mobility solutions so as to help streamline and optimize traffic management.

- **Transport economics.** Financing of public transport, cost-benefit analysis and pricing strategies.

- **Urban Freight Distribution.** Assessment of the impact of e-commerce on urban mobility and strategies for optimizing the delivery.

- **Green transport.** Environmental impact of several transportation modes and developing strategies and measures to reduce the impacts. The analysis has been focused mainly on port and urban freight sectors.

- **Digitalization.** Impact of digitalization on transport operations and economics, drivers of the digitalization, disruptive technologies. The main focus has been on port sector, urban transport and road freight transport.

Staff

Sergi Saurí (Leader)

Awais Muhammad
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Esther Blanco
Jacqueline Davies
Andrés Reyes Díaz
Francesc Gasparín

Maurici Hervas
Genís Majoral
África Marrero
Francisco Rodero
Paola Rodriguez
Samra Sarwar
Guillermo Solinas

On-going RTD Projects

EnerNETMob - Mediterranean Interregional Electromobility Networks for intermodal and interurban low carbon transport systems
EC - MED Programme 2014-2020
Coordinator: REGPEL
01/02/2018 - 31/01/2022

HALLO – Hubs for Last Mile Delivery Solutions
EC - HE - EIT
Coordinator: Área Metropolitana de Barcelona
01/04/2021 - 31/03/2022

K1 - KIDS FIRST
HE (2021-2027) - EIT
Coordinator: CIMNE
01/01/2022 - 31/12/2022

LASH FIRE - Legislation Assessment addressing Safety Hazards of Fire and Innovations in Ro-ro ship Environments - EC - H2020 (2014-2020)
Coordinator: RISE
01/05/2019 - 30/04/2023

OCEAN - Operator-Centered Enhancement of Awareness in Navigation
EC-HE (2021-2027) - 5.Climate, Energy&Mobility
Coordinator: HVL - *01/10/2022 - 30/09/2025*

PIONEERS – PORTable Innovation Open Network for Efficiency and Emissions Reduction Solutions
EC- H2020
Coordinator: Havenbedrijf Antwerpen
01/10/2021 - 30/09/2026

SUPORT - Captura y valorización de CO2 para el desarrollo de una ruta sostenible para producir combustibles verdes sintéticos para el transporte marítimo
MICINN – Generación de Conocimiento
Coordinator: IREC - *01/12/2022 - 30/11/2025*

Naval and Marine Engineering

CIMNE has a large experience in conducting RTD projects in naval and marine engineering.

The main activities in these fields are related to the development, application and customization of computational methods, computer aided design and verification tools on the following topics:

• Development of semi-Lagrangian methods for hydrodynamics.
• Development of computational methods for seakeeping.
• Development of computational methods for hydroelasticity of marine structures.
• Development of methodologies for fatigue assessment of floating structures.
• Artificial intelligence applied to seakeeping.
• Fully coupled simulation of floating offshore wind turbines.

Development of an IoT platform and implementation of digital twin models for manufacturing processes in shipbuilding, aiming at:

a) Providing an IoT platform based on industry standards and the extension of open source libraries.
b) Providing a methodology to create digital twins of the different production processes fed with the monitoring system data.

Development of a hydroelastic seakeeping solver based on structural reduce order models with application to:

a) Hydroelastic analysis of floating structures.
b) Development of digital twins for structural health monitoring.
c) Fatigue assessment of floating structures.

Development of state-of-the-art semi-Lagrangian methods with applications to:

a) Hydrodynamics.
b) Non-linear Seakeeping.

Development of state of the art semi-Lagrangian methods with applications to:

a) Hydrodynamics.
b) Non-linear Seakeeping.

On-going RTD Projects

FIBRE4YARDS - FIBRE composite manufacturing technologies FOR the automation and modular construction in shipYARDS
EC - H2020
Coordinator: CIMNE - *01/01/2021 - 31/12/2023*

FIBREGY - Development, engineering, production and life-cycle management of improved FIBRE-based material solutions
EC - H2020
Coordinator: CIMNE - *01/01/2021 - 31/12/2023*

prodPhD - Social network tools and procedures for developing entrepreneurial skills in PhD programmes - EC - H2020
Coordinator: CIMNE- *01/01/2021 - 31/12/2022*

MLAMAR - Development of a Machine Learning strategy for hydroelastic analysis of ships
MICINN- Generación de Conocimiento
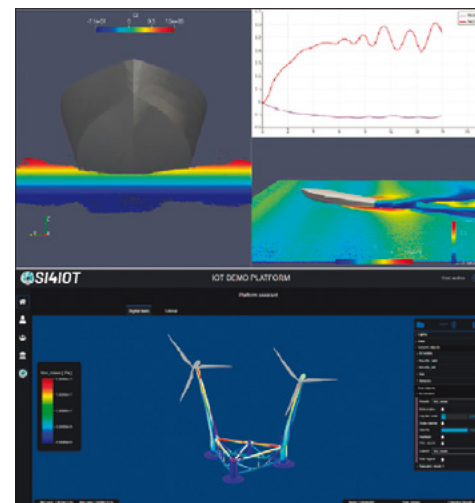Coordinator: CIMNE - 01/09/2022 - 31/08/2025

Staff

Borja Serván (Leader)   Rafael Pacheco
Irene Berdugo   Andrés Pastor

Information and Communication Technology

The Information and Communication Technology Group is an R&D group of CIMNE expert in providing new services, applications and solutions based on the state-of-the-art of groundbreaking ICT technologies ranging from Artificial Intelligence to Internet of Things, Blockchain and GIS.

The main research lines of CIMNE TIC consist of Artificial Intelligence technologies, IoT platforms, Decision Support Systems, GIS technologies, Blockchain and Web and App technologies covering different fields in engineering such as civil, maritime, aerospace, environmental, agricultural, manufacturing, mechanical, telecommunication and biomedical engineering.

Research

Computation and Information Technologies
PIs: J. Jiménez and Ángel Priegue

• IOT Technologies
• AI Technologies (ML, DL, TinyML)
• Blockchain
• GIS Technologies & Simulations
• Computer Vision
• DSS/EWS/CPS/ Monitoring Platforms Development
• Biomedical Signal Processing
• Web/App Development
• Proactive Communications Tools
• Water
• Data analytics
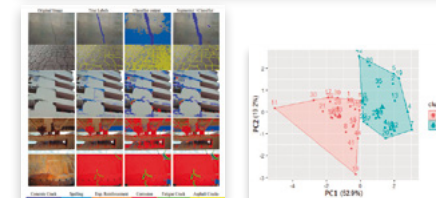
Staff

Ángel Priegue and Jordi Jiménez (Leaders)

Pedro A. Arnau
Ferran Arrufat
Laura Almunia
Alberto Burgos
Alexis Cid

Sergi Macian
Andreu Marí
Javier Soraluce
Alberto Tena
Sergio Valero
Claudio M. Zinggerling

Ongoing projects

LIFE4MEDECA - Support for the preparation of Emission Control Areas in the Mediterranean Sea
EC - LIFE (2014-2020)
Coordinator: Autorità di Sistema Portuale del Mar Tirreno Centro Settentrionale - *01/01/2021 - 31/12/2023*

GAVIUS - From reactive to proactive public administrations
EC - UIA Initiative - Coordinator: Ajuntament de Gavà
01/09/2019 - 28/02/2023

LASH FIRE - Legislation Assessment addressing Safety Hazards of Fire and Innovations in Ro-ro ship Environments
EC - H2020 - SC4 - Smart, green & integrated transport
Coordinator: RISE
01/09/2019 - 31/08/2023

PIPLATES - Plataforma de Predicció Territorial
GENCAT
Coordinator: CIMNE - *01/07/2021 - 31/12/2022*

PECT InnoDelta - Projecte d'Especialització i Competitivitat Territorial InnoDelta
GENCAT
Coordinator: Viladecans City Council
30/04/2021 -31/12/2023

Pre and Post-Processing

The Pre and Postprocessing Group works on the development of advanced methods for efficient generation of data for numerical simulations and visualization of computational results. This group holds the development team of the commercial pre and postprocessing environment GiD, which is a universal pre and post-processor for numerical simulations.

Research

• **Computational Geometry. PI: E. Escolano**
  • Computer Aided Design (CAD) tools development to cover numerical simulation tools.
  • Adaptation of CAD tools to deal with real complex industrial models

• **Mesh Generation. PI: A. Coll**
  • Development and improvement of mesh generation tools for numerical simulations, covering the needs of all CIMNE groups devoted to numerical simulations, as well as the GiD users.
  • Advanced mesh generation techniques for 3D images to get simulation mesh automatically from the input 3D images data.
  • Implementation of GiDMeshLibrary to allow the use of meshing and remeshing techniques directly from the simulation solvers.

• **Postprocessing for numerical simulations. PI: M. Pasenau**
  Development of advanced postprocessing techniques for numerical simulations, specially for cases of huge distributed results focused on High Performance Computing (HPC) architectures.

• **Advanced visualization. PI: M. Pasenau**
  Advanced 3d visualization techniques adapted for numerical simulations, considering very big models and sets of results, as well as remote solutions to allow the use of light devices (mobile) for visualizing simulations adapted to cloud architectures.

• **Software arquitecture. PI: A. Melendo**
  • Design of Graphical User Interface (GUI) for simulation software, and customization of solvers to be integrated in GiD pre and postprocessing platform.
  • Adaptation of cloud architectures to cover the needs of simulation software, and implementation of a new platform for simulations based on Software as a Service (Saas) business model paradigm.
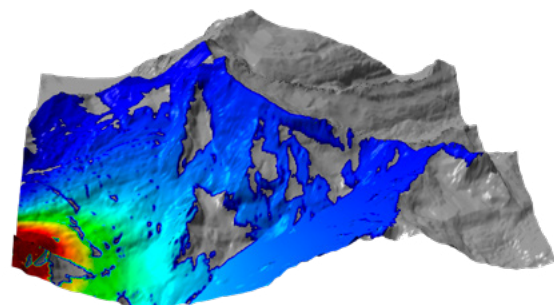
On-going RTD Projects

NextSim - CODA: Next generation of industrial aerodynamic simulation code
EC-H2020 - Coordinator: BSC
01/03/2021 - 29/02/2024
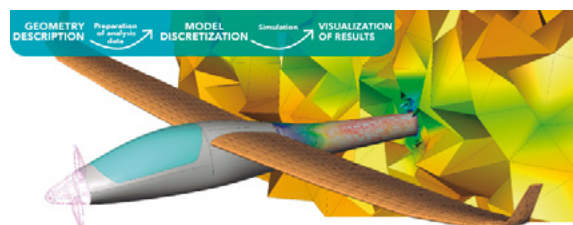
Staff

Abel Coll (Leader)

Enrique Escolano
Javier Gárate
Adrià Melendo
Anna Monros

Miguel Pasenau
Maria Rosa Peyrau
Laura Santos

Valorization of Research and Technology Transfer

The Valorization of Research and Technology Transfer (VRTT) Group focuses on the development and implementation of innovative procedures for transforming the outputs of RTD activities of CIMNE into useful prototypes and products of practical interest and their subsequent transfer to industry.

The VRTT Group mission is to transfer technology in its broadest sense, by helping to identify and by putting together all the key players in the entire value chain of technology, from creators to distributors in the market. Moreover, the aim of VRTT Group is take new discoveries and innovations from the research and turn them into products or services that can have benefit and Impact on society.

Two main tools are used by CIMNE for the technology transfer: Technology License agreements and creation and shareholding in spin-offs.

The VRTT Group works in cooperation with **CIMNE Tecnologia SAU,** the spin-off company of CIMNE (100% owned by the centre) responsible for taking into market the outcomes of the research activities of CIMNE (*www.cimnetecnologia.com*).

New technologies under valorization process during year 202
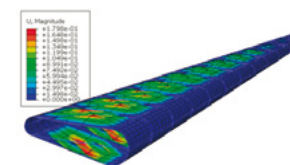
Applications of inflatable technologies to develop a new generation of windmill blades to facilitate logistics in the deployment.

One of the main problems for the assembly of wind turbines is the transfer by road of their large blades. It is one of the main limitations in several geographic locations. The use of blades made up of a combination of inflatable structures and a frame of rigid elements that can be assembled on-site, will make it easier to transport the blades in these cases.

BIM TeamUp web platform for the collaborative storage and management of digital information from projects in the construction sector.

The platform has been developed and market by the CIMNE spin-off company Scipedia: *bim-teamup.com* with applications in the construction and naval sector. **BIM TeamUp** centralizes all the digital information of a project created by different agents and facilitates the management of the development of the project and the management of the built infrastructure along its practical life.

BIM TeamUp has been successfully implemented at the project management department of the Ministry for Digital Technology and Territory (VPDiT) of the Catalan Government, as well as in the public company Infraestructures (*https://infraestructures.gencat.cat*) with the aim of facilitating the procurement of projects in the construction sector using BIM technology. Currently, some 300 projects of different infrastructures developed using BIM have been stored in the BIM TeamUp repository.

OKOTAGS. Digital communication channel for municipalities and private and public organizations. (Market by OKTICS – *okobusiness.com*)

In 2022, the ICT Group of CIMNE has developed in cooperation with the company **OKTICS ATZ SL** (25% owned by CIMNE) the product **OKOTags** (*okotags.com*).

OKO Tags are a series of digital devices that can be have programmed from a central platform and used as communication channels for the management of organizations, municipalities and business lines of companies. The OKO tags been successfully marketed as a communication channel for municipalities and private and public organizations. OKTICS received in 2021 a **NEOTEC award** (amounting

some 250k eur) from the Centre for the Development of Industrial Technology (CDTI) of the Spanish Government for helping taking into market OKTICS Technology.

Other technologies under valorization process during year 2022

Smart Water: IOT device to measure water consumption from home, clubs, hotels application.
Smart water is an easy-to-install, non-invasive water consumption sensor system that allows the user to track and visualize their water consumption.

Simulation software for analysis and design of centrifugal fertilizer spreaders (SPREADDEM)
cimne.com/spreaddem
SpreadDEM is a simulation software that predicts the flow of particles on centrifugal fertilizer spreaders oriented to designers and producers of agricultural machinery.

Development of software for design and analysis of operations in the oil and gas sector.
Numerical methods and software for the analysis of complex problems in the operation of wells in the oil and gas sector. The projects have been funded by the US company ExxonMobil.

Applications of inflatable technologies to support formworks of large sizes in sewers, dams and galleries.
The application of large scale inflatable elements covered with special protection material to allow the projection of concreate over the structure.
This new technique may drastically reduce the needed to construct formworks, which are very demanding of heavy materials, human and heavy machinery resources.

Applications of Tensairity technology to increase portable capability of formworks for bridges.
The use of Tensairity technology developed for the Ultra-lightweight bridges can help to reduce the amount of steel needed in large formworks.
It is expected to reduce about 3 times the need of heavy steel frames, reducing time and resources nee-

ded to set-up large formworks in roads, bridge and buildings.

Applications of IOT, Digital Signage and Smart Communications to support operations and maintenance in municipalities and public spaces.
Use of IOT technologies to improve the interaction of different physical elements in the municipalities with the citizens and maintenance staff.

Inflatable Breakwaters for sand beach protection.
CIMNE has developed a concept of inflatable breakwater for protection and regeneration of the coast line. Research has included the development of theoretical :
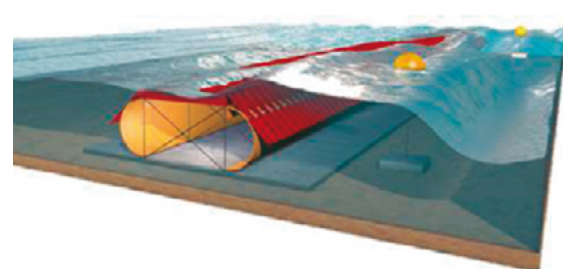
Metamaterials solutions
Development of new complex materials designed partially by the application of numerical methods considering:
• Composed by a multiscale elements (nano, micro) physically interacting and coupled by a matrix of materials.
• This multiscale factor gives to the meta-material improved properties according to the specific design.

Application of inflatable tubes for sewers maintenance in road preservation.
Development and manufacturing of inflatable tubes to be used as formworks to allow reinforce damaged culverts with injected concrete.
This solution allows to increase the free space when making structural reinforcements of culverts. What allows to maximize the passage of water when there are floods.

Staff

Jordi Jiménez (Leader) | Javier Marcipar | Jazmín Ríos

Publications

CIMNE publishes books, journals, monographs, scientific reports and educational software on the theory and applications of numerical methods in engineering and applied science.
The publications of CIMNE can be visited and ordered via Internet on the website books.cimne.com. Most publications can be freely downloaded from the web. We list below the publications of CIMNE in 2022.

NUMBER OF CIMNE PUBLICATIONS (1987–2022)	
Edited books	87
Text books	48
Research reports	417
Technical reports	643
Monographs	279
Papers in journals (since 2009)	1.292

Journals

Archives of Computational Methods in Engineering. **Editors:** Kleiber M., Oñate E. Springer, 2021. Journal Impact Factor (2021): 7.302; 5 Year Impact Factor (2021): 8.169; Downloads (2021): 322.209.

Revista Internacional de Métodos Numéricos para Cálculo y Diseño en Ingeniería. Editors: Oñate E., Idelsohn S.R., Scipedia, 2021. Views: 77031; Score percentile: 100; Impact Factor (2021): 0.513

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Assaf R., Birk C., Natarajan S., Gravenkamp H., Three-dimensional phase-field modeling of brittle fracture using an adaptive octree-based scaled boundary finite element approach, *Computer Methods in Applied Mechanics and Engineering*, vol. 399, 2022.
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Badia S., Neiva E., Verdugo F., Linking ghost penalty and aggregated unfitted methods, *Computer Methods in Applied Mechanics and Engineering*, vol. 388, 2022.
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Barceló-Mercader J., Codony D., Fernández-Méndez S., Arias I., Weak enforcement of interface continuity and generalized periodicity in high-order electromechanical problems, *International Journal for Numerical Methods in Engineering*, vol. 123, issue 4, pp. 901-923, 2022.
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Castañar I., Baiges J., Codina R., Venghaus H., Topological derivative-based topology optimization of incompressible structures using mixed formulations, *Computer Methods in Applied Mechanics and Engineering*, vol. 390, 2022.
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Cózar I.R., Otero F., Maimi P., González E.V., Miot S., Turón A., Camanho P.P., A three-dimensional plastic-damage model for polymer composite materials, *Composites Part A: Applied Science and Manufacturing*, vol. 163, 2022.
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Dawi M.A., Sànchez-Vila X., Simulating degradation of organic compounds accounting for the growth of microorganisms (Monod kinetics) in a fully Lagrangian framework, *Journal of Contaminant Hydrology*, vol. 251, 2022.
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Dialami N., Chiumenti M., Cervera M., Chasco U., Reyes-Pozo G., Pérez M.A., A hybrid numerical-experimental strategy for predicting mechanical response of components manufactured via FFF, *Composite Structures*, vol. 298, 2022.
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Espinoza V.S., Fontalvo J., Martí-Herrero J., Miguel L.J., Mediavilla M., Analysis of energy future pathways for Ecuador facing the prospects of oil availability using a system dynamics model. Is degrowth inevitable?, *Energy*, vol. 259, 2022.
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González-Blanco L., Romero E., A multi-scale insight into gas transport in a deep Cenozoic clay, *Geotéchnique*, 2022.
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Hashemi M.R., Rossi R., Ryzhakov P.B., An enhanced non-oscillatory BFECC algorithm for finite element solution of advective transport problems, *Computer Methods in Applied Mechanics and Engineering*, vol. 391, 2022.
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Kaurin D., Bal P.K., Arroyo M., Peeling dynamics of fluid membranes bridged by molecular bonds: moving or breaking, *Journal of the Royal Society Interface*, vol. 19, issue 191, 2022.
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Laguna G., Mor G., Lazzari F., Gabaldon E., Erfani A., Saelens D., Cipriano J., Dynamic horizon selection methodology for model predictive control in buildings, *Energy Reports*, vol. 8, pp. 10193-10202, 2022.
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Lohner R., Antil H., Giménez J.M., Idelsohn S., Oñate E., A deterministic pathogen transmission model based on high-fidelity physics, *Computer Methods in Applied Mechanics and Engineering*, vol. 401, 2022.
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Monforte L., Arroyo M., Carbonell J.M., Gens A., Large-strain analysis of undrained smooth tube sampling, *Geotéchnique*, vol. 72, issue 1, pp. 61-77, 2022.
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Moreira C.A., Barbat G.B., Cervera M., Chiumenti M., Accurate thermal-induced structural failure analysis under incompressible conditions, *Engineering Structures*, vol. 261, 2022.
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Núñez M., López I., Baiges J., Rossi R., An embedded approach for the solution of the full potential equation with finite elements, *Computer Methods in Applied Mechanics and Engineering*, vol. 388, 2022.
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Oñate E., de Pouplana I., Zárate F., Explicit time integration scheme with large time steps for first order transient problems using finite increment calculus, *Computer Methods in Applied Mechanics and Engineering*, vol. 402, 115332, 2022.
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Ordaz M., Mánica M.A., Salgado-Gálvez M.A., Osorio L., Inclusion of site-effects: An approach coherent with contemporary event-based PSHA practices, *Soil Dynamics and Earthquake Engineering*, vol. 158, 2022.
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Pons-Prats J., Zivojinovic T., Kuljanin J., On the understanding of the current status of urban air mobility development and its future prospects: Commuting in a flying vehicle as a new paradigm, *Transportation Research Part E: Logistics and Transportation Review*, vol. 166, 2022.
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Pinyol N.M., Di Carluccio G., Alonso E.E., A slow and complex landslide under static and seismic action, *Engineering Geology*, vol. 297, 2022.
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Shafique M., Saurí S., Investigating the impact of information sharing in human activity recognition, *Sensors*, vol. 22, issue 6, art. n. 2280, 2022.
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Silva-Cancino N., Salazar F., Sanz-Ramos M., Bladé E., A machine learning-based surrogate model for the identification of risk zones due to off-stream reservoir failure, *Water (Switzerland)*, vol. 14, issue 15, 2022.
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Tena A., Claria F., Solsona F., Automated detection of COVID-19 cough, B*iomedical Signal Processing and Control*, vol. 71, 2022.
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Vila-Pérez J., Giacomini M., Sevilla R., Huerta A., A non-oscillatory face-centred finite volume method for compressible flows, *Computers and Fluids*, vol. 235, 105272, 2022.
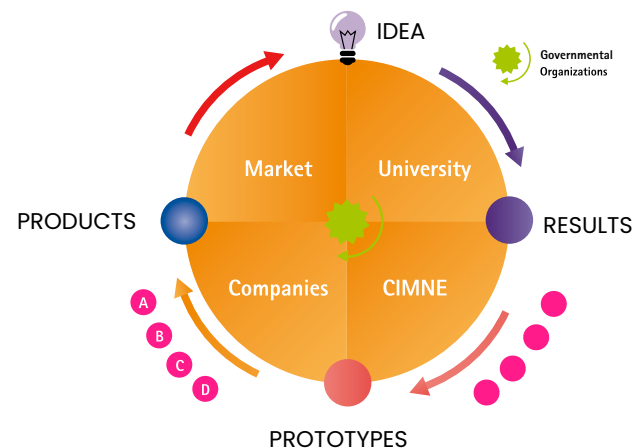10.1016/j.compfluid.2021.105272

Innovation and technology transfer

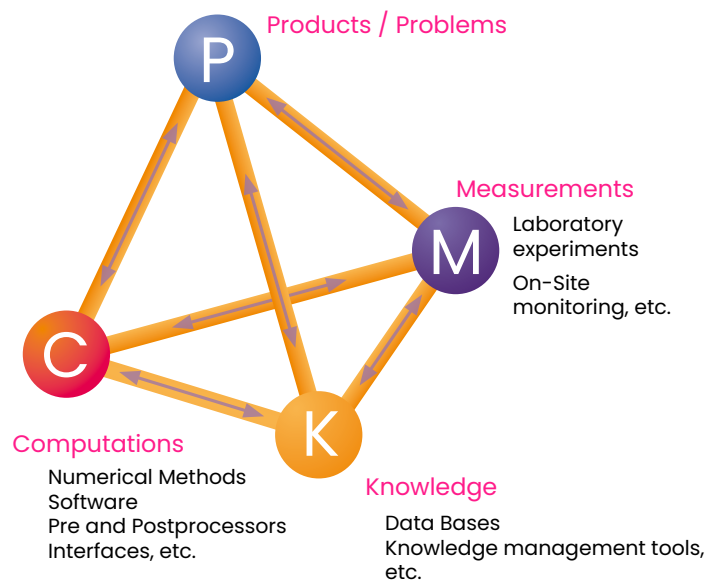**CIMNE RTD activities are based on a holistic approach.**

CIMNE aims at providing comprehensive solutions for solving problems that affect human beings, through the integration of existing knowledge in a particular field with quantitative information emanating for prediction methods, such as computational-based techniques, and experimental measurements.

These four concepts: the problem to be solved, computational methods, experimental methods and existing knowledge can be represented by the tetrahedron shown in the figure above. Each of the nodes is connected to the other three by lines that represent information transfer pipelines.

The holistic approach for solving problems at CIMNE:

Products / Problems

Measurements
Laboratory experiments
On-Site monitoring, etc.

Computations
Numerical Methods
Software
Pre and Postprocessors
Interfaces, etc.

Knowledge
Data Bases
Knowledge management tools, etc.

The mission and activity of CIMNE can be explained through the so-called Cycle of Ideas:

IDEA

Governmental Organizations

Market

University

PRODUCTS

RESULTS

Companies

CIMNE

A
B
C
D

PROTOTYPES

Ideas (scientific advances) usually originate in university environments, where many professionals study, investigate and discover new areas of knowledge. The idea matures until it produces tangible results (thesis, papers, computer programs, physical devices, etc.) that have to be filed and protected. **Results** evolve until they reach the level of a prototype (a software code, a system, a device, etc.). The transit of a result to a prototype demands an organization, efficient and capable staff and resources. What it is desirable is that the idea follows its route on specialized institutions, adjacent to the university, such as CIMNE, with the mission of transforming knowledge into tangible things (prototypes). The **prototype** develops into a product within a company. The cycle follows with the marketing of the **product** and ends up with the reinvestment of part of the revenues in the development of new ideas.

A description of the Cicle of Ideas at CIMNE could be downloaded from *cimne.com/cycle-ideas*
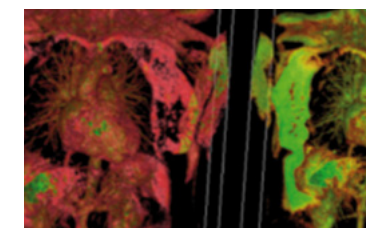
CIMNE Products

PRE AND POST PROCESSING SOFTWARE

GID

A universal and adaptive pre and postprocessor for computer simulation in engineering and applied science. Developed & marketed by CIMNE since 1998.
✚ **www.gidsimulation.com**

DIPPO

Versatile platform for digital image processing combined with numerical modelling and simulations.
Developed and marketed by CIMNE since 2011.

ENGINEERING SYSTEMS AND HARDWARE

INFATABLE STRUCTURES

Inflatable pavilions, shelters and bridges for applications in engineering and architecture.
Developed by Buildair and CIMNE.
Marketed by Buildair since 2002.
✚ **buildair.com**

OKO

Software and hardware for the intelligent management of audiovisual content and digital signage.
Developed by CIMNE.
Marketed by OKTICS ATZ SL.
✚ **okobusiness.com**

COOL STEAM

Fresh water production system.
Developed by CIMNE and Fresh Water Nature, SL.
Marketed by Fresh Water Nature, Ltd. since 2016.
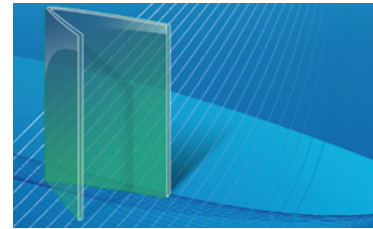✚ **freshwaternature.com**

COLLABORATIVE WORK PLATFORMS

EDUCATIONAL SOFTWARE

LHINGS

Cloud platform to provide access and links to all kind of things and let users management, share and interaction with them. Developed and marketed by Lyncos SL and CIMNE. ✪ **lhings.com**
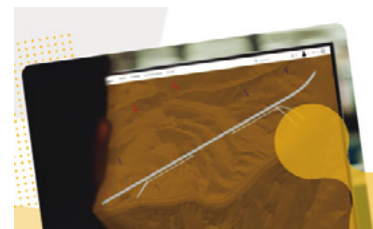
SIGPRO

Integrated software platform for the management of the research and financial activities and reports in RTD projects. Developed by CIMNE.
✪ **cimne.com/sigpro**

MAT-FEM

Educational program in MATLAB for introduction to the finite element method for analysis of structures and field problems.
Developed by CIMNE.
✪ **cimne.com/mat-fem**

SCIPEDIA

Web platform for free publishing and open access of scientific publications. Developed by Scipedia, S.L. in cooperation with CIMNE. Marketed by Scipedia, S.L. since 2016.
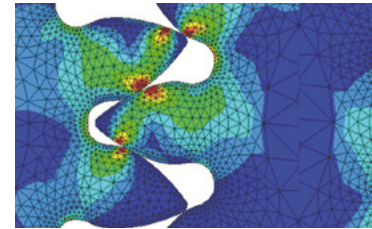✪ **scipedia.com**

BIMTEAM

Daily management of all the models and data associated with a BIM project.
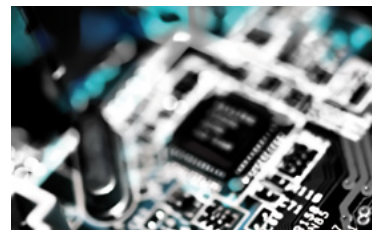Developed by Scipedia.
✪ **bim-teamup.com**

VLAB

An open-source software, a simple virtual press to simulate destructive tests of models and obtain valuable information afterwards.
Developed by CIMNE.
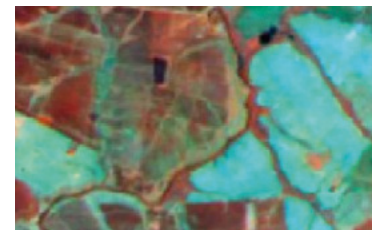✪ **vlab.cimne.com**

DECISION SUPPORT SYSTEMS

RMO

Integrated platform for robust multiobjective optimization in engineering.
Developed by CIMNE.
✪ **tts.cimne.com/RMOP**

GIS+

Web-based interactive Geographic Information System.
Developed by CIMNE.

SIE

Information system for management of energy consumption in public buildings and municipalities. Developed by CIMNE. Marketed since 2005 by Gassó Auditores SL and CIMNE. ✪ **inergybcn.com**

DECISION SUPPORT SYSTEMS

ROEM

Information system for assessment of the environmental quality in reservoirs and lakes.
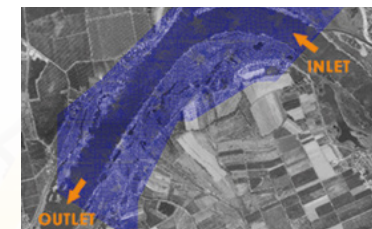Developed by CIMNE.

E-TESTING

Web-based platform for e-management of experimental tests. Developed by CIMNE and Applus.
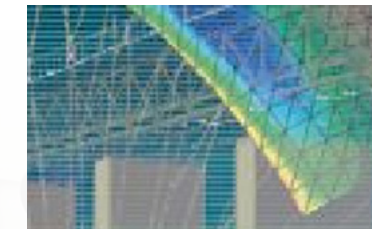
FLOOD

Artificial neuronal network package. Developed by CIMNE.
✪ **cimne.com/flood**

RAMFLOOD

Decision support system for risk assessment and managing of floods. Developed by CIMNE and Flumen.
✪ **www2.cimne.com/ramflood**

WSNP

An integrated platform for e-monitoring using wireless sensor network technology.
Developed by CIMNE.
✪ **www2.cimne.com/wsnp**
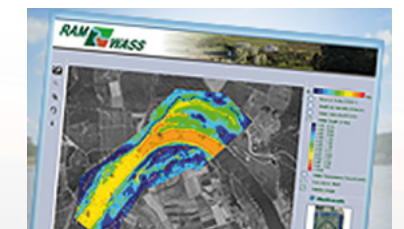
RAMWASS

Decision support tool for the risk assessment and management of environmental and human-induced hazards on the water/sediment/soil system in fluvial ecosystems. Developed by CIMNE.
✪ **www.cimne.com/ramwass**

BEE DATA
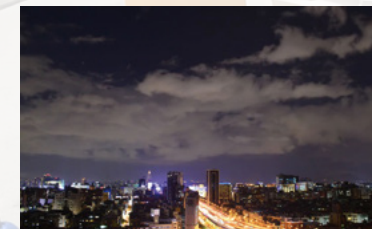
Open source BiG Data Analytics platform for deep analysis of massive data coming from smart metering infrastructure of utility companies. Developed by CIMNE and marketed by Inergy.
✪ **beedataanalytics.com**

SIMULATION SOFTWARE FOR INDUSTRIAL PROCESSES

WELDPACK

Welding processes software. Developed by CIMNE.

STAMPACK

Software for sheet metal forming processes. Developed by Quantech ATZ, SA and CIMNE. Marketed by Quantech ATZ, SA since 1999.
✪ **stampack.com**

CLICK2CAST

Software for fast simulation of casting processes. Developed by Quantech ATZ in cooperation with CIMNE. Marketed by Altair since 2015.

SCUT

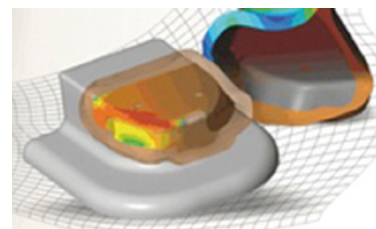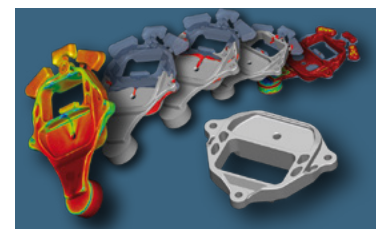Software able to simulate cutting processes for the metal manufacturing industry. Developed by CIMNE.

ADD2MAN

Additive manufacturing processes software. Developed by CIMNE in cooperation with Eurecat.
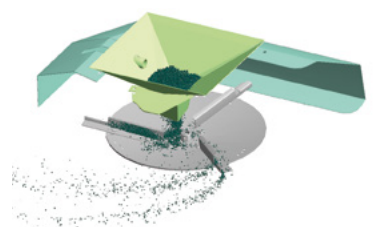
FORGEPACK

Forging manufacturing processes software. Developed by CIMNE.

MACHPACK

Software able to simulate machining manufacturing processes. Developed by CIMNE.

SPREADDEM

Simulation software for the study of the particle flow on centrifugal fertilizer spreaders. Developed and marketed by CIMNE.
✪ **cimne.com/spreaddem**

SIMULATION SOFTWARE FOR MULTIPHYSICS

KRATOS
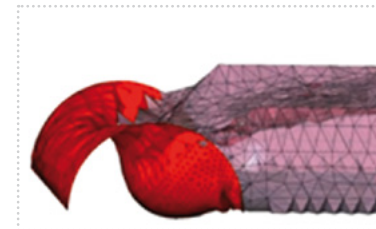
Object-oriented software platform for the development and application of finite element codes for multidisciplinary applications. Developed by CIMNE.
✪ **cimne.com/kratos**

ERMES
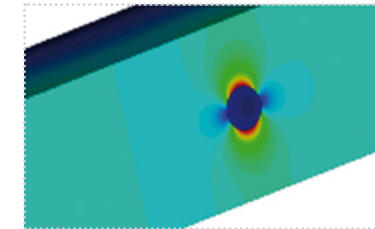
Computational electromagnetics using advanced finite element methods. Developed by CIMNE.
✪ **tts.cimne.com/ermes**

PFIRE

Analysis of propagation of fire and its effect on the burning and melting of objects. Developed by CIMNE.

SIMULATION SOFTWARE FOR FLUID DYNAMICS

TDYN

Finite element code for analysis of a wide range of multi-physic problems in engineering and applied science. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE. Marketed by Compass since 2003. ✪ **compassis.com**

SEAFEM
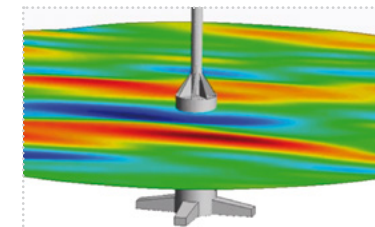
Hydrodynamics and seakeeping analysis of ships and marine structures. App for wind tower generators in the sea. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE. Marketed by Compass since 2011.
✪ **compassis.com**

PFLOW

Analysis of fluid dynamics and fluid-structure-soil-thermal interaction problems into the Particle Finite Element Method (PFEM). Developed by CIMNE.
✪ **cimne.com/pfem**

PARACHUTES
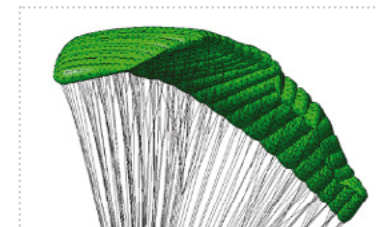
Computer program for the fast simulation of parachute-payload systems. Developed and marketed by CIMNE since 2016.
✪ **cimne.com/parachutes**

SIMULATION SOFTWARE FOR STRUCTURAL AND GEOTHECNICAL ENGINEERING

RAMSERIES
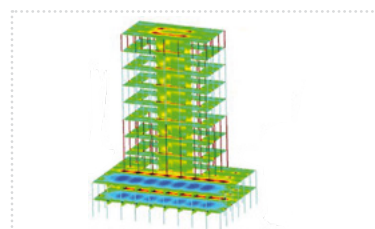
Finite element code for analysis of structures in engineering and architecture. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE.
Marketed by Compass since 2003.

➕ **www.compassis.com**

DEMPACK

Analysis of granular systems and multifracturing problems in geomechanics and industrial processes using discrete and finite element methods. Developed by CIMNE.

➕ **cimne.com/dem**

COMET

Finite element code for none linear analisys of thermomechanical problems in solid and structural mechanics acounting for frictional contact situations. Developed by CIMNE.

➕ **cimne.com/comet**

CODE_BRIGHT

Finite Element Method (FEM) program capable of performing coupled thermo-hydro-mechanical (THM) analysis in geological media.

➕ **https://deca.upc.edu/en/projects/code_bright**

BIOMECHANICS & HEALTH
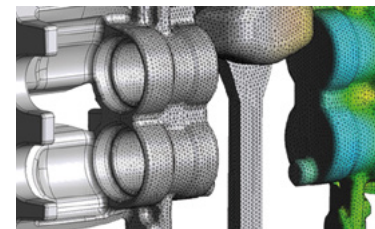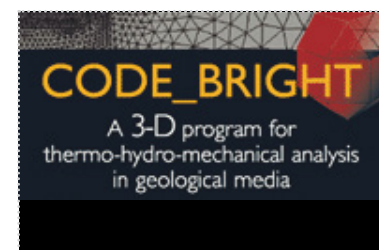
BODYGID
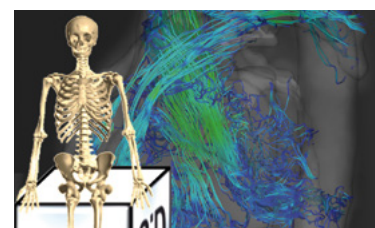
Multiscale representation and analysis of the human body. Developed by CIMNE.

HEALTH APP

App to control eating disorders. Developed by HealthApp in cooperation with CIMNE. Marketed by HealthApp SL since 2014.

➕ **bcnhealthapp.com**
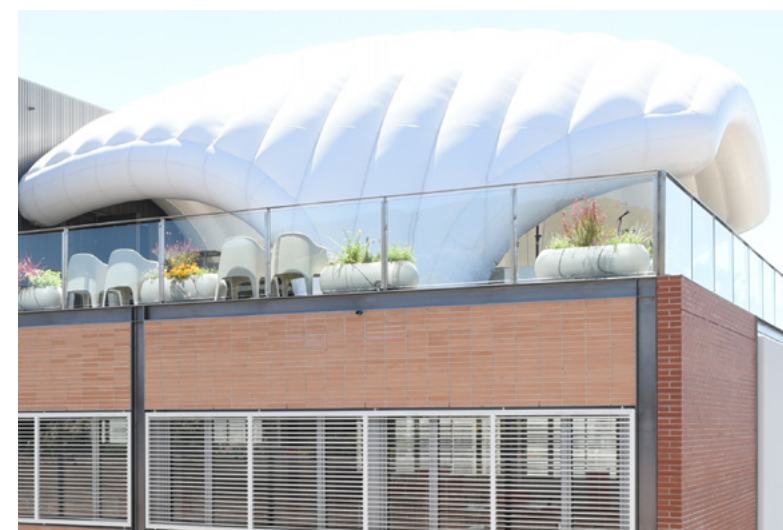
VISIT CIMNE PRODUCTS AT
CIMNE.COM/PRODUCTS

Spin-off companies

COMPANIES CREATED BY CIMNE:

SOLUCIONES INTEGRALES DE FORMACIÓN Y GESTIÓN STRUCTURALIA, SA
Created in 2001

➕ **structuralia.com**

Training and consulting activities in the civil engineering via Internet. It was sold in 2011 to KAPLAN (The Washington Post Group).

COMPASS INGENIERÍA Y SISTEMAS, SA
Created in 2002

➕ **compassis.com**

It develops commercial activities related to numerical methods in engineering, with emphasis on civil, naval and maritime engineering. CIMNE owns 24% of COMPASS.

QUANTECH ATZ
Created in 1996

➕ **quantech.es**

Development and marketing of simulation software for production processes.

CIMNE TECNOLOGÍA, SAU

Created in 2011

➕ **cimnetecnologia.com**

CIMNE Tecnologia SAU is managed by an administration committee formed by the following persons:
- **Chair:** Ferran Falcó
- **Members:** Xavier Baulies, Josep Mª Gassó, Daniel Marco, Eugenio Oñate, David Prat and Lluís Rovira.

The Director General of the company is Javier Marcipar.

COMPANIES CREATED BY CIMNE TECNOLOGIA SAU

BUILDAIR INGENIERÍA Y ARQUITECTURA, SA
Created in 2001

➕ **buildair.com**

Inflatables structures for engineering and architecture applications.

LYNCOS TECHNOLOGIES, SL
Created in 2012

➕ **lhings.com**

Software and systems for the Internet of Things.

PORTABLE MULTIMEDIA SOLUTIONS, SL
Created in 2013

➕ **portablemultimediasolutions.com**

Mobile pavilions with multimedia technology for leisure, sport and events.

PNEUMATIC STRUCTURES TECHNOLOGIES, SL
Created in 2015

➕ **ps-technologies.com**

Pneumatic structures for a wide range of engineering problems.

COMPANIES WITH PARTICIPATION OF CIMNE TECNOLOGIA SAU

beedata

BEEDATA ANALYTICS, SL
Created in 2017
☑ **beedataanalytics.com**
ICT services based on mass analytical data treatment to users and business intelligence for companies and institutions. CIMNE Tecnología owns 36,35% of Beedata

citechsa

COMPUTATIONAL AND INFORMATION TECHNOLOGIES, SA
Created in 2012
☑ **citechsa.com**
Computational methods and information technology systems in engineering. 100% owned by CIMNE Tecnología SA.

FWN

FRESH WATER NATURE, SL
Created in 2013
☑ **freshwaternature.com**
Solutions for obtaining fresh water from desalination and destillation of waste water.
The company is 92,99% owned by CIMNE Tecnología SA.

inerGy

RSM GASSÓ CIMNE ENERGY, SL
Created in 2012
☑ **inergybcn.com**
Advanced engineering energy services. CIMNE Tecnología, SA. owns 50% of Inergy.

INLOC ROBOTICS, SL
Created in 2014
☑ **inlocrobotics.com**
Positioning and navigation solutions for mobile robots in buried environments. CIMNE Tecnología owns 6,19% of INLOC Robotics since October 2015.

META MATERIALS SOLUTIONS

METAMATERIALS SOLUTIONS, SL
Created in 2021
Design, develops and commercialize through joint ventures, new meta-materials to provide new and extreme solutions to daily-life engineering problems.

OKO

OKTICS ATZ, SL
Created in 2019
☑ **okobusiness.com**
Digital Signance Technologies and products.
CIMNE Technología, SA owns the 24,5% of OKTICS ATZ SA.

SCIPEDIA

SCIPEDIA, SL
Created in 2015
☑ **scipedia.com**
Free publishing and open access for scientific publications. CIMNE Tecnología owns 16,67% of Scipedia, SL.

VISIT
CIMNE COMPANIES AT
CIMNE.COM/COMPANIES

Alliances

CIMNE, leader in research on computational engineering, has established relevant alliances with international institutions and companies since its creation in 1987.

CIMNE host of UNESCO Chair of Numerical Methods in Engineering Since 1989.

Prof. Olgierd Zienkiewicz was UNESCO Chair until his death (2009).

SEMNI
Secretariat of SEMNI Since 1989

Pilot Center of ERCOFTAC in Spain Since 1989

ECCOMAS
Secretariat of ECCOMAS Since 1992

iacm
Secretariat of IACM 1994 - 2016

Partner of FLUMEN Since 2012

AIAC Asociación Internacional de Aulas CIMNE
Creation of AIAC Since 2015

Dr. Jacques Périaux

Unesco Chair in Numerical Methods in Engineering

FLUMEN Institute

The main mission of the Chair is to promote the development, dissemination and application of numerical methods in engineering at an international level, through education, research and technology transfer, with the aim of contributing to the solution of complex problems in lower-income countries.

Prof. O. C. Zienkiewicz held the UNESCO Chair since its creation in 1989 until his death on January 2nd, 2009. Since 2009 Dr. Jacques Périaux is the Chairholder of the Unesco Chair of Numerical Methods in Engineering. He is a recognized expert in the field of numerical methods applied to aerospace engineering.

Dr. Périaux contributions have resulted in a significant increase in the RTD activities of CIMNE in the aerospace sector, in particular with academic organizations and industry in China, the organization of numerous training courses, exchanges with leading scientists worldwide and several RTD projects at an international level.

It is important to note that computational methods are especially useful in resource-limited countries because they enhance the ability of people to predict outcomes and optimize solutions before committing resources to specific investments.

An important UNESCO Chair activity over the years has been the creation of a series of "Aulas CIMNE" (CIMNE Classrooms), physical spaces of collaboration with other research groups in universities and research centres located mainly in Latin America and Europe. All nodes in the network connected to each other are using, transforming and broadcasting knowledge generated in CIMNE over the last thirty years.

Both the people and the knowledge generated by the network members easily circulate within the network. "Aulas CIMNE" is now a growing network of centres of excellence in research and training in the field of numerical methods. A priority in the network is the promotion of joint projects in research and training using international competitive funds and existing programs that target specific local needs. Links with scientific groups and other organizations established locally are also actively encouraged.

Dr. Cecilia Soriano is the coordinator of the UNESCO Chair of Numerical Methods in Engineering.

In 2022, the 30th Anniversary of the UNITWIN/UNESCO Chairs Programme been celebrated. Read more about it in the section "2022 in news" (page 10).

FLUMEN Institute is the outcome of merging the prestigious Flumen RTD group existing since 2005 at the School of Civil Engineering of UPC · BarcelonaTech and CIMNE, bringing together the numerical and experimental expertise of Flumen RTD group in hydraulics with the broad experience of CIMNE on numerical methods, computer simulation and integration of decision support systems.

The objectives of FLUMEN are the promotion of RTD and technology transfer activities in the field of river dynamics and hydrologic engineering. The Flumen Institute is directed by Prof. Ernest Bladé.

FLUMEN Premises

Flumen Institute is located at the B0 Building in the North Campus of UPC · BarcelonaTech since 2016. The building is equipped with modern experimental facilities for model scale testing of river dynamic and hydraulic problems. It also provides work areas for researchers at the graduate level (masters, doctoral and postdoc) and for senior researchers from CIMNE and UPC · BarcelonaTech.
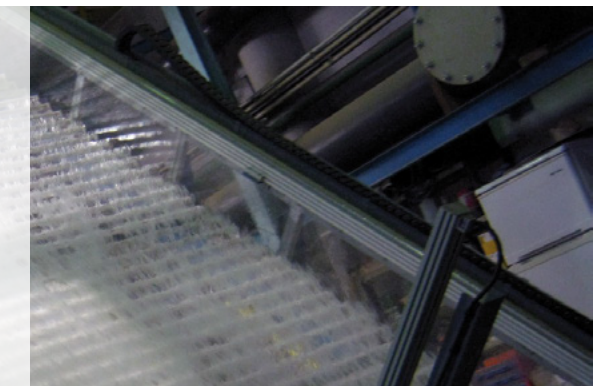
Flumen is actively engaged in research activities, consulting, training and technology transference in relation to hydrology and river dynamics.

www.flumen.upc.edu

# Sociedad Española de Métodos Numéricos en Ingeniería Computacionales

SEMNI aims at organizing and coordinating activities related to numerical methods in engineering in Spain and being the Spanish representative in the International Association for Computational Mechanics (IACM).

SEMNI is linked to similar associations in other countries, such as the European Community on Computational Methods in Applied Sciences (ECCOMAS), the International Association for Computational Mechanics (IACM), the Groupe pour l'Avancement des Méthodes Numériques de l'Ingénieur in France and the United States Association for Computational Mechanics in the United States, among others.

The headquarters and the secretariat of SEMNI are based in CIMNE. Currently, SEMNI has over 400 members worldwide.

Some of the main activities of SEMNI include the organization of technical workshops and the organization of the Spanish Conference on Numerical Methods in Engineering, held every two years.

SEMNI organized the congress Congress on Numerical Methods in Engineering (CMN 2022) on September 12-14, 2022, in the city of Las Palmas de Gran Canaria (Spain). It was attended by more than 160 experts.
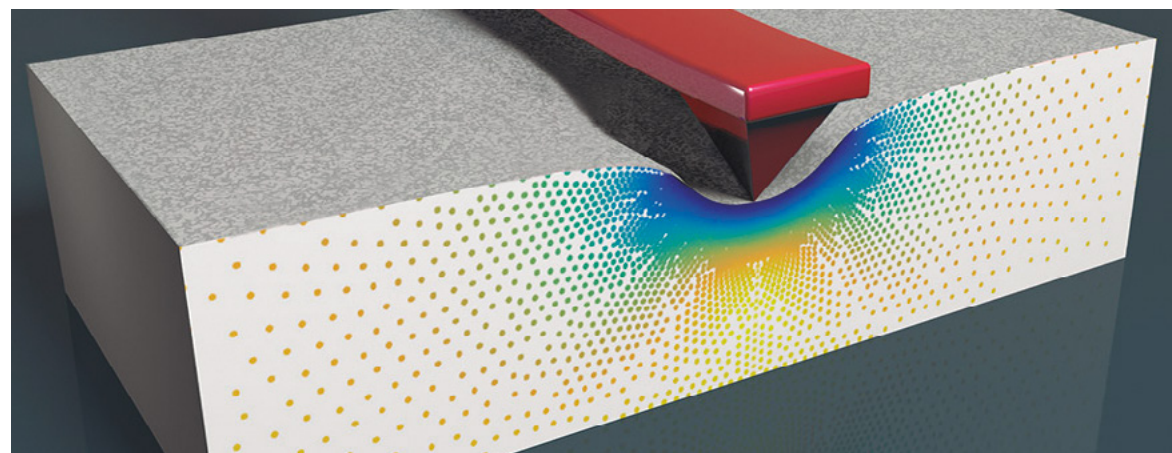
European Community on Computational Methods in Applied Sciences

The mission of ECCOMAS is to promote joint efforts of European universities, research institutes and industries which are active in the broad field of numerical methods and computer simulation in Engineering and Applied Sciences (i.e. Computational Solid and Structural Mechanics, Fluid Dynamics, Acoustics, Electromagnetics, Physics, Chemistry, Applied Mathematics, and Scientific Computing), to address critical societal and technological issues with particular emphasis on multidisciplinary applications and disseminate innovative research.

The three main scientific events that ECCOMAS organizes every four years are the ECCOMAS Congress, the ECCOMAS Conference on Computational Solid and Structural Mechanics (ECCM) and the ECCOMAS Conference on Computational Fluid Dynamics (ECFD). They attract approximately 5,000 participants in total.

The ECCOMAS Congress is addressed to scientists and engineers both in and outside Europe. Its main objective is to provide a forum for presentation and discussion of state-of-the-art in scientific computing applied to engineering, with emphasis on basic methodologies, scientific development and industrial applications. It also includes invited lectures, Special Technological Sessions (STS), contributed papers from Academy and Industry and organized Minisymposia. Proceedings of the ECCOMAS Congresses are widely disseminated in Europe.

These series of ECCOMAS global meetings are complemented with more focused thematic conferences on state-of-the-art topics in computational sciences and engineering.

From 5th to 9th June, 2022, the Eccomas Congress 2022 gathered 1870 experts in Oslo (Norway). This meeting will be repeated by the beginning of June 2024 in Lisbon (further details at **eccomas2024.org**).

Since 1989 CIMNE supports the activities of the Spanish Association for Numerical Methods in Computational Engineering (SEMNI).

ECCOMAS is a scientific organization founded in 1992. It groups European associations with interests in the development and application of computational methods in applied sciences and technology. The ECCOMAS Secretariat is located at CIMNE.

The International Association for Computational Mechanics (IACM) was founded in 1981 and, since then, it has been strongly connected to CIMNE.

The ERCOFTAC network was founded in 1987. It is promoted by several European aerospace companies and it groups together more than 60 research centres and companies working primarily in the numerical simulation of fluid mechanics problems in engineering.

International Association for Computational Mechanics

The goal of IACM is the promotion of advances in computational mechanics in a wide sense. IACM defines computational mechanics as the development and application of numerical methods and digital computers to solve problems in engineering and applied sciences with the objectives of understanding and harnessing the resources of nature.

Computational Solid Mechanics (CSM) and Computational Fluid Dynamics (CFD) are at the core of IACM activity. Subjects such as thermodynamics, electromagnetics, rigid body mechanics, control systems and some aspects of particle physics fall naturally within the scope of the IACM. Indeed providing a common forum for discussion, education and re-search information transfer between the diverse disciplines represented is the main raison d'être of IACM.

Dissemination

IACM publishes a periodic bulletin and supports Special Interest Conferences, IACM Symposia and courses in various fields of computational mechanics.

The 16th World Congress on Computational Mechanics – PANACM2024 will take place in online mode from 21th to 26th July, 2024, in Vancouver (Canada).

Further info: iacm.info/scientific-events/wccm

European Research Community on Flow, Turbulence and Combustion

Since 1989, CIMNE is a Pilot Centre of ERCOFTAC in Spain.

CIMNE, acting as Pilot Centre, has organized a number of activities, including, among others, the 8th European Turbulence Workshop (Barcelona 2000), the Europe-Russia Workshop (Barcelona 2006), the 3rd Workshop on Research in Turbulence (Seville 2008), the 5th Workshop on Research in Turbulence (Tarragona 2010) and ERCOFTAC Spring Festival (Terrassa 2014).

CIMNE has coordinated the FP7 E-Caero projects 1 and 2 (E-CAERO: European Collaborative Dissemination of Aeronautical research and applications, 2009-2013 and 2014-2017).

Both projects aim to promote joint activities of different scientific associations in the aeronautic field in Europe. ERCOFTAC is a partner in both projects.

Related event
- **2nd Spanish Fluid Mechanics Conference**
  2nd - 5th July 2023
  Universitat Politècnica de Catalunya (UPC)
  Barcelona, Spain

The International Association of Aulas CIMNE (AIAC) is a non-governmental non-profit civil organization with the objective of fostering the advances of numerical methods in a common academic space: the Aulas CIMNE (Joint Labs). Aulas CIMNE are the basis for cooperation in scientific, technological and training among its members, aiming to achieve social and economic improvements in society.

International Association of Aulas CIMNE

Mission

To contribute to the development, strengthening and consolidation in:

• Training, by promoting and organizing courses of interest to its members.

• Scientific and technological research, including the processes of innovation, adaptation and technology transfer in strategic areas.

• The use of numerical methods in engineering as a tool to help developing countries.

The interaction of the members of the Association with the society at large, by disseminating scientific and technological advances that drive progress.

AIAC members benefit from:

• Continuous education, enhancing the set of high-level human resources of Aulas CIMNE and the Network and by the competitive advantage of installed capacity in the regions.

• The development of multi- and inter-disciplinary activities in areas of basic research, applied research and experimental developments.

• Exchange programs for teachers, researchers, students and academic and innovation managers.

• Research and development programs in emerging knowledge areas, related to new professional profiles identified as strategic.

AIAC's vision

To promote a common project and create a network of experts from around the world, which results in the international benchmark in the field of numerical methods in engineering.

AIAC intends to encompass an international environment in which scientists, technical staff and engineers can benefit directly from CIMNE's tools (developed or in development), international collaborations, participation in projects, exchange of information and industry technology transfer, among others.

Dissemination

Knowledge transfer is of vital importance for CIMNE, which invests great efforts in training and education adressed to its research staff as well as to graduates and professionals from schools of engineering and universities in applied sciences.

CIMNE regularly organises Severo Ochoa Seminars, Severo Ochoa Coffee Talks, courses and post-graduate studies related to the theory and application of numerical methods in engineering. It has also developed a web environment for distance learning education via Internet.

The research centre plays also an important role as event organizer in the field of computational engineering. In the following pages, a summary of the conferences organized by CIMNE Congress Bureau during 2022. The agenda of congresses and conferences that will take place during 2023-2024, it is also included.

EXCELENCIA SEVERO OCHOA

POST-GRADUATE STUDIES

COURSES

SEMINARS

COFFEE TALKS

CONFERENCES

12 SO seminars

385 attendees

Available online

100% hybrid/online format

Training

Post-graduate Studies

CIMNE supports the organization of the following postgraduate degrees awarded by the UPC · BarcelonaTech.

Master Degrees

Master on Numerical Methods in Engineering
Duration: 2 academic years, 120 ECTS
• Line 1. Local Master Degree
• Line 2. International Double
  Degree*:
  Programme in Computational Mechanics
  * Double Degree UPC BarcelonaTech + universities of Swansea, Nantes, Stuttgart or Padova

🔗 cimne.com/education

Doctoral Degrees

PhD Degree in Civil Engineering
Duration: PhD studies, 3 years period
🔗 cimne.com/phd-civil

PhD Degree in Structural Analysis
Duration: PhD studies, 3 years period
🔗 cimne.com/phd-structural

Courses

CIMNE is also been organizing courses and workshops related to its field of expertise:

Ibercursos
Online courses held in 2022:
• Initiation (English)
• Advanced courses (only in Spanish): Dam breaks; Water quality; Hydraulic works; Sediment transport

CIMNE Winter School 2022
24 - 28 January 2022, Barcelona, Spain

Curso Explosivos 2022
25 - 29 April 2022, CIMNE/UPC, Barcelona

Severo Ochoa Workshop for Postdocs at CIMNE
5 May 2022, Barcelona, Spain

GiD Convention 2022
1 June 2022, Online

CIMNE Summer School 2022
04 - 08 July 2022, Barcelona, Spain

8th edition "Course of positive energy buildings. Beyond the nZEB"
2 November - 14 December 2022, Barcelona (hybrid)

Workshop on Innovative Scientific/Technical Approaches for a Climate Neutral Air Transport
22 - 24 November 2022, Barcelona, Spain

Formación sobre distribución de última milla
21 - 30 November 2022, Barcelona, Spain

🔗 cimne.com/training

Severo Ochoa (SO) Seminars at CIMNE in 2022

Challenges on modeling service life of structural concrete
Carmen Andrade
Online – 09/03/2022

Multi-phase analysis of polymer electrolyte fuel cells at multiple scales
Marc Secanell
Hybrid –23/03/2022

The Cartesian grid Finite Element Method (cgFEM) for patient-specific simulations
Enrique Nadal
Hybrid – 06/04/2022

Numerical framework for fatigue simulation
Lucía Barbu
Online – 20/04/2022

How to generate solutions to technology and industry inspired by a scientific use of computational mechanics
Norberto M. Nigro
Hybrid – 28/04/2022

A dual-primal finite element tearing and interconnecting method for nonlinear variational inequalities utilizing linear local problems
Chang-Ock Lee
Online – 04/05/2022

"How to build Well-Balanced Teams to foster the Innovation Process?"
TalentUp!
Hybrid – 29/06/2022

Accelerating the design of active materials through multifunctional topology optimization
Rogelio Ortigosa
Online – 13/07/2022

Asymptotic self-similar blow up profile for 3-D Euler via physics-informed neural networks
Javier Gómez-Serrano
Hybrid - 15/07/2022

Some algorithmic advances for multiphysics, boundary conditions and deep neural nets
Rainald Lohner
Hybrid - 19/07/2022

A discrete element model compatible with continuum mechanic constitutive laws
Damien André
Online – 21/09/2022

Inherent strain solution for 3D printing simulations
Pooyan Dadvand
Hybrid -16/11/2022

🔗 cimne.com/seminars

18
Coffee talks

436
attendees

Available online

94%
hybrid/online format

Severo Ochoa (SO) Coffee Talks at CIMNE in 2022

PiPlates Special Series: Challenge 2 - Estimation of beach width scenarios on the Catalan coast
Pere-Andreu Ubach and Marc Catasús | Online –19/01/2022

PiPlates Special Series: Challenge 4 - A micro-scale pollutant distribution model for urban areas
Ignasi de Pouplana | Online – 02/02/2022

PiPlates Special Series: Challenge 3 - Design of tools to predict episodes of exceeding ozone concentration limits
Cecilia Soriano and Eva Pérez | Online – 16/02/2022

What´s new in the Kratos problemtype in GiD
Javier Gárate | Online - 02/03/2022

PiPlates Special Series: Challenge 0 - Disaster risk assessment in Catalonia
Liliana Carreño and Ernest Bladé | Online - 16/03/2022

PiPlates Special Series: Proposal for development of a marketplace for a numerical method/simulation oriented GIS++ system
Laurence Sigler | Online - 30/03/2022

Constrained powder sintering
Aatreya Venkatesh and Brayan Paredes | Online - 07/04/2022

PiPlates Special Series - Analysis of human frequentation in natural spaces
Pedro Arnau | Online - 27/04/2022

PiPlates Special Series: Challenge 1 - Patterns of occupation of spaces for more predictive urban management and planning
Gerard Mor and Julia Trias | Online - 11/05/2022

[Round table] - Working on site in times of the artificial intelligence
Pol Toledano, Felipe Muñoz and Andrés Llopis | Hybrid - 24/05/2022

Automating the creation of VR experiences as learning pills for the construction sector
Ma Jesús Bopp | Hybrid - 08/06/2022

PiPlates Special Series - Design of a platform with a multiscalar, multiengine and multidisciplinary vocation, as an evolution from GIS systems based on data to GIS systems based on models and computation
Claudio Zinggerling | Online - 08/06/2022

Experiences of CIMNE in Ecuador in appropriate technologies
Jaime Martí | Online - 06/07/2023

Developments for a computational tool for prediction of the plan and transversal beach profile
Lucie François | Hybrid - 05/10/2022

Design and implementation of serious games on extended reality: a use case in construction safety
María Jesús Bopp | Hybrid - 13/10/2022

Health, Maths and Biomimetics: machine learning method to classify biomarker patterns of precancerous lesions
Xóchitl Siordia-Vásquez | Hybrid - 26/10/2022

The beauty of symmetries
Carlos Heredia | Hybrid - 23/11/2022

ACROPOLIS: Classification of off-stream reservoirs against potential risk combining GIS and Machine Learning
Fernando Salazar, Nathalia Silva, Ernest Bladé and Marcos Sanz | Hybrid - 14/12/2022

Conferences organized by CIMNE in 2022

CIMNE gathered some 4,000 experts in the six international congresses organized during 2022, which are listed below:
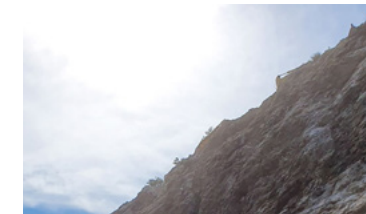
ECCOMAS CONGRESS 2022
5 - 9 June 2022, Oslo, Norway

11th International Conference on Bridge Maintenance, Safety and Management - IABMAS 2022
11 - 15 July, 2022, Barcelona, Spain

Congress on Numerical Methods in Engineering - CMN 2022
12 - 14 September 2022, Las Palmas de Gran Canaria, España

X Simposio Nacional sobre Taludes y Laderas Inestables
13 - 16 September 2022, Granada, España

Sefi Annual Conference - SEFI 2022
19 - 22 September, 2022, Barcelona, Spain

12th EASN International Conference
18 - 21 October 2022, Barcelona, Spain

Upcoming conferences organized by CIMNE in 2023 & 2024

CFC 2023
Computational Fluids Conference
25 - 28 April 2023
Cannes, France

COUPLED PROBLEMS 2023
Intal Conf. on Computational Methods for Coupled Problems in Science and Engineering
5-7 June 2023
Chania, Island of Crete, Greece

MARINE 2023
International Conference on Marine Engineering
27-29 June 2023
Madrid, Spain

SFMC 2023
Spanish Fluid Mechanics Conference
2 - 5 July 2023
Barcelona, Spain

CSAI 2023
ECCOMAS Thematic Conference on Computational Science and AI in Industry
28-30 August
Trondheim, Norway

Compwood2023
Computational Methods in Wood Mechanics
5-8 September 2023
Desdren, Germany

STRUCTURAL MEMBRANES 2023
International Conference on Textile Composites and Inflatable Structures
2-4 October 2023
Valencia, Spain

M2P 2023
Math 2 Product
30 May - 1 June 2023
Sicily, Italia

ADMOS 2023
International Conference on Adaptive Modeling and Simulation
19-21 June 2023
Göteborg, Sweden

ICTW 2023
International Couette Taylor Workshop
28 - 30 June 2023
Barcelona, Spain

Sim-Am 2023
International Conference on Simulation for Additive Manufacturing
26 - 28 July 2023
Munchen, Germany

COMPLAS 2023
International Conference on Computational Plasticity
5-7 September 2023
Barcelona, Spain

Composites 2023
ECCOMAS Thematic Conference on the Mechanical Response of Composites
12 - 14 September 2023
Trapani, Sicily, Italy

PARTICLES 2023
International Conference on Particle-Based Methods
9-11 October 2023
Miilano, Italy

ECCOMAS 2024
9th European Congress on Computational Methods in Applied Sciences and Engineering
3 - 7 June 2024
Lisbon, Portugal

cimne.com/conferences

Awards   Chronology of the prizes awarded to CIMNE

Below we briefly review some of the awards granted to the research centre along its history.

SPECIAL MENTION TO THE CIUTAT DE BARCELONA AWARD 1999
Special Mention to the Ciutat de Barcelona Award 1999 in the category of Technological Research for the work carried out by Drs. P. Roca, M. Cervera and E. Oñate on the modelling and structural analysis of the Barcelona Cathedral.

NARCÍS DE MONTURIOL PLATE AWARD TO THE SCIENTIFIC AND TECHNOLOGICAL MERIT 1999
In 1999 the Generalitat de Catalunya granted to CIMNE the Narcís de Monturiol Plate Award for Scientific and Technological Merit:
• For its contribution to the development of new methods for analysis and design for products and processes in engineering.
• For fostering the cooperation between industry and university research groups.
• For the organization of training activities and the promotion of science and technology at an international level.

2002 IST PRIZE TO THE BEST PRODUCT OF THE INFORMATION SOCIETY TECHNOLOGIES, EUROPEAN COMMISSION (EC)
The EC granted the IST Award to the pre/post processor system GiD *(www.gidsimulation.com)* developed at CIMNE.

CIUTAT DE BARCELONA 2002 AWARD IN TECHNOLOGICAL RESEARCH
On February 11th, 2003, the Ciutat de Barcelona Award in Technological Research was awarded to the CIMNE research team formed by Eugenio Oñate, Ramon Ribó, Enrique Escolano, Miquel Pasenau and Jorge Suit Pérez.
The prize recognized the development of the pre/postprocessor GID.

AWARD DURAN I FARRELL FOR RESEARCH AND TECHNOLOGY UNIVERSITAT POLITÈCNICA DE CATALUNYA, 2004
The Award was delivered to CIMNE scientists Dr. Oñate and Dr. García for their work entitled: "Development of a new finite element code for the hydrodynamic study of vessels. Aplications to the design of sailing ships for the America Cup race".

SEVERO OCHOA ACCREDITATION
CIMNE is a "Centre for Excellence Severo Ochoa" accredited by the Spanish State Research Agency (attached to the Spanish Ministry of Science, Innovation and Universities) for the period December 2019-December 2024.

CUBAN NATIONAL PRIZE 2016 TO THE SCIENTIFIC RESEARCH RESULT BY THE CUBAN ACADEMY OF SCIENCES
This award is a recognition of the research work entitled "Development of advanced technologies for the generation and packaging of particles focused on the methods of discrete elements".
The research was carried out by the Central University "Las Villas" of Cuba (UCLV) and the CIMNE within the Aula UCLV-CIMNE. It also involved the collaboration of the universities of Leuven (KU Leuven, Belgium), and Brasilia (UnB, Brazil), as well as foreign and local institutions.

FIMA 'TECHNICAL NOVELTY' AWARD 2018
The Centrifugal Spreading Simulation Software, SpreadDEM, developed by CIMNE, has been awarded by the 40th International Fair of Agricultural Machinery (FIMA) with the "Technical Novelty" award in the category of "Agricultural Management Solution". With this award, the Fair recognizes the companies that present devices and systems with direct application in agriculture and rural areas, which bring remarkable innovation to the sector.

cimne.com/awards

Awards to CIMNE scientists in 2022
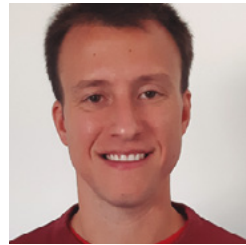
Baiges, Joan

ECCOMAS Olgierd Cecil Zienkiewicz Award, ECCOMAS, 2022.

Giacomini, Mateo

Juan Carlos Simó Prize, SEMNI, 2022.

Bonet, Javier

IACM O.C. Zienkiewicz Award, International Association for Computational Mechanics, 2022.

Idelsohn, Sergio

AMCA Internacional Award 2022, Argentine Association of Computer Mechanics, 2022.

Calpe, Miguel

2nd Award to the best talk at the 61st Congress on Naval and Maritime Engineering, 2022.

Oliver, Xavier

Narcís Muntoriol Medal, Government of Catalonia, 2022.

Cornejo, Alejandro

Special Doctoral Award, Doctorate School of the Technical University of Catalonia BarcelonaTech, 2022.
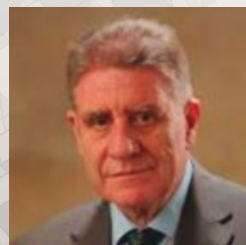
Roca, David

Special Doctoral Award, Doctorate School of the Technical University of Catalonia BarcelonaTech, 2022.

Cavaliere, Fabiola

Pioner Prize awarded by CERCA for her PhD thesis "Static and dynamic global stiffness analysis for automotive pre-design", 2022.

Sáez, Raúl

SESAR Young Scientist Award 2022, SESAR 3 Joint Undertaking, 2022.

Gens, Antonio
Honorary member, Spanish Rock Mechanics Society, 2022.
**Terzaghi Oration**, International Conference on Soil Mechanics and Geotechnical Engineering, 2022.
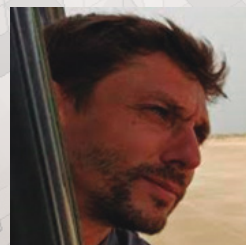
Serván, Borja

Second Award to the best talk at the 61st Congress on Naval and Maritime Engineering, 2022.

CIMNE in the Media in 2022

CIMNE's scientific activity has had a presence in the media during 2022, highlighting its presence in online, specialized and local media. We list below some examples of appearances in the press.

MOBILE APP TO DETERMINE LUNG AGE
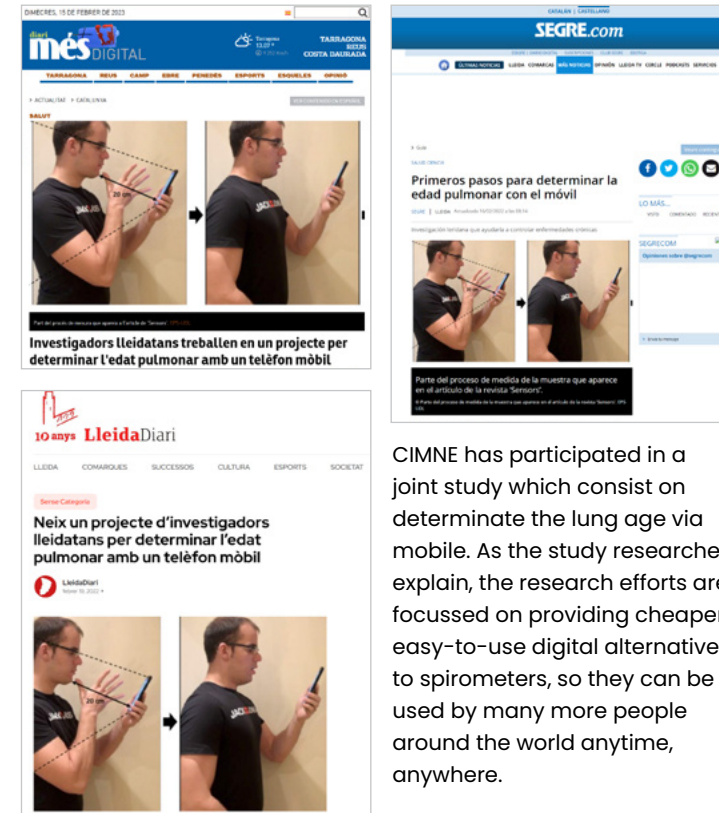
CIMNE has participated in a joint study which consist on determinate the lung age via mobile. As the study researchers explain, the research efforts are focussed on providing cheaper, easy-to-use digital alternatives to spirometers, so they can be used by many more people around the world anytime, anywhere.

DESALINATION CIMNE'S PILOT PROJECT AT PLOCAN

The transnational cooperation project for the development of a solution that saves energy and water in coastal facilities through ocean energy capture devices (COOSW), financed by the State Research Agency, tests the technology COOL STEAM at the Canary Ocean Platform (PLOCAN). COOL STEAM is a seawater desalination system by vacuum distillation developed by CIMNE.

NEW GENERATION WIND PLATFORMS

Fibregy is an ambitious European innovation project that will enable the extensive use of fiber reinforced polymers (FRP) for the next generation of offshore and wind turbine platforms.

Led by CIMNE, the Fibregy consortium is working on the development of new construction procedures and design guidelines to make the extensive deployment of FRP materials feasible in wind and tidal turbine platforms in high sea.

PROJECT OF SPECIALIZATION AND TERRITORIAL COMPETITIVENESS INNODELTA

CIMNE participates as a technological partner in the InnoDelta Territorial Specialization and Competitiveness Project (PECT). It is a territorial specialization and competitiveness project financed by the Government of Catalonia and the European Commission through FEDER funds. Its mission is to create a laboratory territory of the industrial network to promote environmental, social and economic sustainability solutions.

Dissemination Matters

A science activity to be explained

CIMNE has an intense research activity to explain to society. With this purpose, its comms department carries out an 360º communication strategy, which includes social media entries, posts on the corporate website, the publication of a periodical newsletter, among other communication tools. We highlight below three of them tools, so you can get familiarized with them.

CIMNE Newsletter

A perfect place to get informed!
Keep in mind that sometimes, we take advantage of the celebration of a world day to go deeper into a special issue. Thus, you will find in the archive of our website monographs on the world day of women in science or engineering for sustainable development.

Four Newsletter has been published during 2022.

Twitter

CIMNE carries out an intensive activity through social media, with special attention to Twitter, where the centre has more than 2.300 followers.

@cimne

Audiovisual repository

Most of the Severo Ochoa Seminars & Coffee Talks can be found on our Youtube Channel, but not only. Visit them and discover CIMNE projects, simulations, etc.

@CIMNEMC

International Centre for Numerical Methods in Engineering

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