International Centre for
NUMERICAL METHODS IN ENGINEERING

35 YEARS

/ CIMNE R
1987– 2022

EXCELENCIA
SEVERO
OCHOA

Since 1987
GENERATING KNOWLEDGE AND SOLUTIONS

ANNUAL REPORT 2021

2021 Annual Report

ANNUALREPORT2021.CIMNE.COM

GENERATING KNOWLEDGE AND SOLUTIONS
Since 1987

CIMNE

CIMNE ANNUAL REPORT 2021 ›
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PressureDrop

0.0e+00   500   1000   1500   2000   2500   3.2e+03

Velocity Magnitude

0.0e+00   5   10   15   20   25   30   35   4.4e+01

About
CIMNE

Director's Letter

Eugenio Oñate is the founding director of CIMNE (1987-2022) and the current vicepresident of CIMNE.
From May 2022, Javier Bonet is the new General Director of CIMNE.

The International Centre for Numerical Methods in Engineering (CIMNE) was created in April 1987. CIMNE's mission is the development and dissemination of original research in the field of Numerical Methods in Engineering, the education of researchers and the transfer of the research outputs to industry.

CIMNE is a leader as an international centre of excellence in the field of numerical methods (NM) through four main action vectors:

1. Excellence in research on NME for multidisciplinary engineering applications, in terms of scientific outputs and software-based tools.
2. International dimension.
3. Active participation and management in scientific societies.
4. Commitment to technology transfer to industry.

Research at CIMNE focuses 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.

Since 1987 CIMNE has evolved to become a prestigious international research centre on NME. Its current research staff (90% of whom are engineers) includes (by December 2021) 19 Full Research Professors, 17 Associate Research Professors, 10 Assistant Research Professors, 26 Postdocs, 11 Staff Scientists, 60 PhD Students, 72 Research Engineers and 38 Administration Staff from more than 20 countries.

Several researchers of CIMNE are faculty members of the Technical University of Catalonia (UPC) and develop their research activity in CIMNE. These distinguished affiliated researchers play an important role as liaison between researchers at different groups of UPC and CIMNE.

1987–2022: 35 YEARS GENERATING KNOWLEDGE AND SOLUTIONS IN COMPUTATIONAL ENGINEERING

In April 2022 CIMNE celebrated its 35th anniversary. During these years CIMNE has built up leadership and prestige as an international centre of excellence in the field of numerical methods in engineering.

In that period, CIMNE has carried out first class research activities in the framework of competitive international and national research programs and research contracts with industry, increased the quality and number of its scientific publications and research outputs, trained excellent researchers at PhD and postdoc levels, extended its international activities in cooperation with its network of academic and industrial partners worldwide, and implemented innovation and technology transfer activities to industry via the CIMNE spin-off companies.

A description of the different activities carried out at CIMNE can be seen at the CIMNE web page

COVID IMPACT

In a situation of a global pandemic, CIMNE activities have been affected. However, the centre has made a strong commitment to teleworking. A notable effort has been made to adapt work meetings, training sessions and congresses to virtual formats. The objective has been to continue advancing in a new and unexplored context.

CIMNE, CENTRE OF EXCELLENCE SEVERO OCHOA

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.

RESEARCH PRIORITIES AND APPLICATIONS

The priorities of CIMNE for research excellence target new NM and software to help engineers to better predict, design and optimize systems affecting our lives, including our environment, our security and safety, and the products we use.

CIMNE research in 2021 has focused in advances on NM that will have an impact on the following four broad application areas that are at the kernel of the activities of CIMNE as a Centre for Excellence Severo Ochoa: Construction and Transport, Environment, Functional Materials and Manufacturing Processes.

Some relevant problems where the NMs developed at CIMNE are applied include: structural analysis of constructions and vehicles; safety of structures to hazards; geotechnical engineering and groundwater flow; oil and gas engineering; thermal-mechanical analysis of structures and mechanical systems; industrial forming processes (sheet forming, casting, welding, additive manufacturing, machining, etc.); shape and material optimization; aerodynamics of aircrafts; blast, crashworthiness and impact problems; ship hydrodynamics; analysis of coastal and offshore structures; flow of granular materials in mining and the oil and gas industries, among other applications.

FOCUS OF CIMNE RESEARCH ON TERRITORY AND SUSTAINABILITY

CIMNE is under the auspices of the Department of Vice-presidency, Digital Policies and Territory of the Catalonian Government. This has broaden 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.

ORGANIZATION OF RESEARCH

Research in CIMNE is structured in research challenges (RChs) covering several challenging topics applicable to different engineering disciplines. See current CIMNE Rchs at the "Research" section of this report.

Researchers at CIMNE carry out their activity within Research and Technical Development (RTD) Groups managed by a Group Leader. The research activities are coordinated by one or more Principal Investigators (PIs). RTD Groups are gathered in RTD Areas that target fields such as Civil and Environment Engineering, Computational Materials Design and Analysis, Engineering Mechanics and Processes, Innovative Algorithms and HPC Techniques and Transport and Innovation Support and Tech Transfer. You can visit the CIMNE RTD Areas and Groups at *www.cimne.com/research*

INTERNATIONAL PRESENCE

CIMNE has established 2 international branches: CIMNE Latin America and CIMNE USA and has also set up an international network of Aulas CIMNE (Joint Labs) with 30 members: 6 in Spain and 24 in Latin America; *aulas.cimne.com*. The International Association of Aulas CIMNE (AIAC), created by CIMNE in 2015, aims to coordinate and foster the activities on the Aulas CIMNE network (See "Alliances Section").

RESEARCH OUTPUTS

In 2021 CIMNE researchers published 128 papers in JCR journals, 75,19% of the papers were published in first quartile journals. Since 1987 CIMNE researchers have published some 3,000 JCR journal papers, 46 text-books, 87 edited books,

278 monographs, 417 RTD reports, 643 technical reports and organized 255 international scientific conferences. CIMNE has 6 patents.

CIMNE scientists are chief editors or associated editors of 6 JCR journals and members of the editorial board of 15 JCR journals.

Since 1987 CIMNE researchers have taken part in 1,786 RTD projects, including 11 projects funded by the European Research Council.

In 2021, CIMNE researchers have taken part in 74 RTD projects funded by international (32 projects) and national (42 projects) organizations which have meant funding of 6,23 M€ for CIMNE. In the same period CIMNE had 132 RTD contracts with companies and private organizations amounting some 2.8 M€.

In 2021 CIMNE managed 2 international MSc courses, 2 PhD programs and organized 12 seminars and 12 CIMNE Coffee Talks. In the same year CIMNE research staff supervised 60 PhDs. 14 PhD theses were successfully completed that year.

Research at CIMNE has lead to many software codes that are useful for solving specific problems in each of the engineering areas addressed. The "CIMNE Products" section of this report lists the main software codes developed at CIMNE.

CITATION RECORDS

By March 2022, CIMNE scientists had an h index of 143 and some 95.000 citations (Source: Google Scholar). Scopus records 576 JCR papers for the period 2016-21.

Several CIMNE researchers are ranked in the first positions of the ranking for Mathematics & Interdisciplinary Applications and others of engineering created by Group for the Dissemination of the h Index (further information *cimne.com/research-rankings*).

By December 2021, the Ranking Web of World Research Centres (*research.webometrics.info*) reports that 128 CIMNE researchers the 100.000 most cited scientists of Spain best scientists in Spain in terms of citations.

MANAGEMENT OF SCIENTIFIC ORGANIZATIONS

CIMNE is the permanent Secretariat of the following scientific organizations:
• International Association for Computational Mechanics (*iacm.info*)
• European Community on Computational Methods in Applied Sciences (*eccomas.org*)
• Spanish Association for Numerical Methods in Engineering (*semni.org*)
• Pilot Centre of the European Research Community in Flow, Turbulence and Combustion (*ercoftac.org*)
• Unesco Chair on Numerical Methods in Engineering of UPC (*cimne.com/unesco*). This is the first UNESCO Chair in the world, created in 1989. Asociación Internacional de Aulas CIMNE (AIAC).

TECHNOLOGY TRANSFER

CIMNE has a vocation for technology transfer. Since 2001 it has launched 20 spin-off companies that market products emanating from CIMNE research. Details are given in Section 3.2 and on *cimne.com/spin-offs* and *www.cimnetecnologia.com*.

AWARDS TO CIMNE AND ITS SCIENTISTS

Since 1987 CIMNE and its scientists have received some 80 awards by national and international organizations. The total list of CIMNE Awards, and those granted in 2021, can be seen on page 103 and on *cimne.com/awards*.

ORGANIZATION OF SCIENTIFIC CONFERENCES

The organization of international scientific conferences and workshops related to the research topics in CIMNE is a relevant part of CIMNE research policy.

Since 1987 the CIMNE Conference Bureau Dpt. has organized some 240 international events. In 2021, 14 international conferences organized by CIMNE were held. Some 20 international events are planned for the period 2022-2024. Details of future and past events organized by CIMNE can be found in Section 5.2 of this report and in *congress.cimne.com*.

| PIV-NP | | |
| MPM | | |

Volumetric strains   Displacements   Shear strains
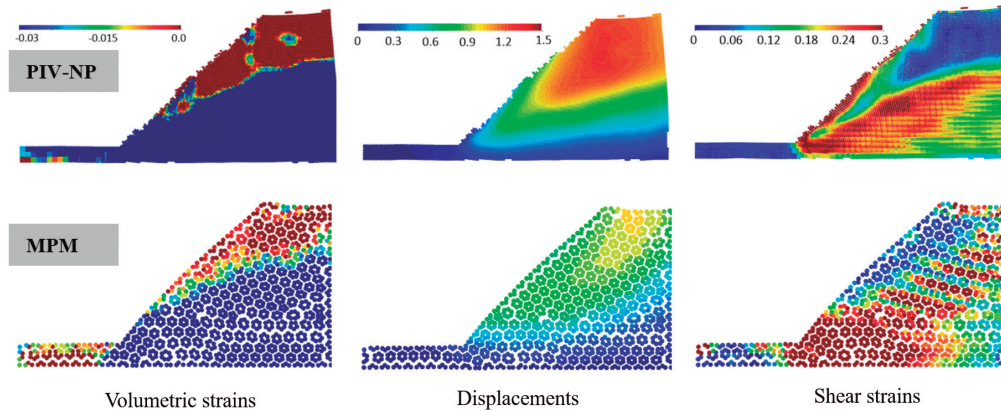
RTD ALLIANCES

CIMNE is a founding partner of the FLUMEN Institute (*www.flumen.upc.edu*). On July 2017 CENIT (Centre for Innovation in Transport, *cenit.es*) merged its current structure into that of CIMNE, thus broadening the scope of the research activities of CIMNE in the field of transport engineering.

CIMNE has established research alliances with numerous prestigious institutions around the world.

A compilation of the most outstanding collaborations can be found in the "Alliances" section of this report.

DISSEMINATION AND COMMUNICATION STRATEGY

Dissemination and communication tasks at CIMNE involve various activities to bring the research outcomes to the attention of as many people as possible. Frequent use of social media tools are used for this purpose (Facebook, Twitter, etc). The Publications Dpt. (cimne.com/publications) of CIMNE publishes research and technical reports, monographs, text and edited books and software codes. The Aulas CIMNE network is also used for dissemination actions.

SCIPEDIA: CIMNE STRATEGY TOWARDS THE HOLISTIC 4.0 OPEN-ACCESS SCIENCE

In March 2016 CIMNE, via its spin-off company Scipedia SL, launched the innovative web platform Scipedia.com with the aim of providing free publishing and Open Access services to disseminate the results of scientific and technical work.

A SELF-SUSTAINED ORGANIZATION

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 2021, the self-obtained income obtained by CIMNE amounted (in average) to some 85% of its total annual budget. Details of the sources of CIMNE funding in 2021 and in recent years can be found on page 12.

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.

Eugenio Oñate
Vicepresident and General Director of CIMNE

CIMNE in Numbers

ACTIVITIES	2021
Postgraduate Studies	4
PhD Theses defended	14
Conferences	14
Seminars	12
Courses	7
Coffee Talks	12
Publications	131
Books	2
Monographs	1
Research Reports	0
Papers in Journals	128
Spin-off Companies	14
Aulas CIMNE	30
Patents	0 (5)
Contracts with Industry	80 (132)
Competitive Projects	20 (73)
National Projects	8 (41)
EU and international Projects	12 (32)

In brackets, the total number of on-going contracts and RTD projects.

ADMINISTRATION STAFF	2021
Management Staff	5
Administration Staff	33
Total	38

RESEARCH SUPPORT STAFF	2021
Staff Scientists	11
Research Engineers	72
Total	83

SCIENTIFIC STAFF	2021
Full Research Professors	19
Associate Research Professors	17
Assistant Research Professors	10
TOTAL PROFESSORS	46
Post Docs	26
PhD Students	60
Undergraduate	7
Total	93
TOTAL ACADEMIC	139

TOTAL PERSONNEL	256
(Information data at 01/02/2022)	

Income from contracts and competitive projects (2002-2021)

*Data: Feb 2022 (Pending audit status)

in M€

- SPANISH AND CATALAN COMPETITIVE PROJECTS
- EUROPEAN AND INTERNATIONAL COMPETITIVE PROJECTS
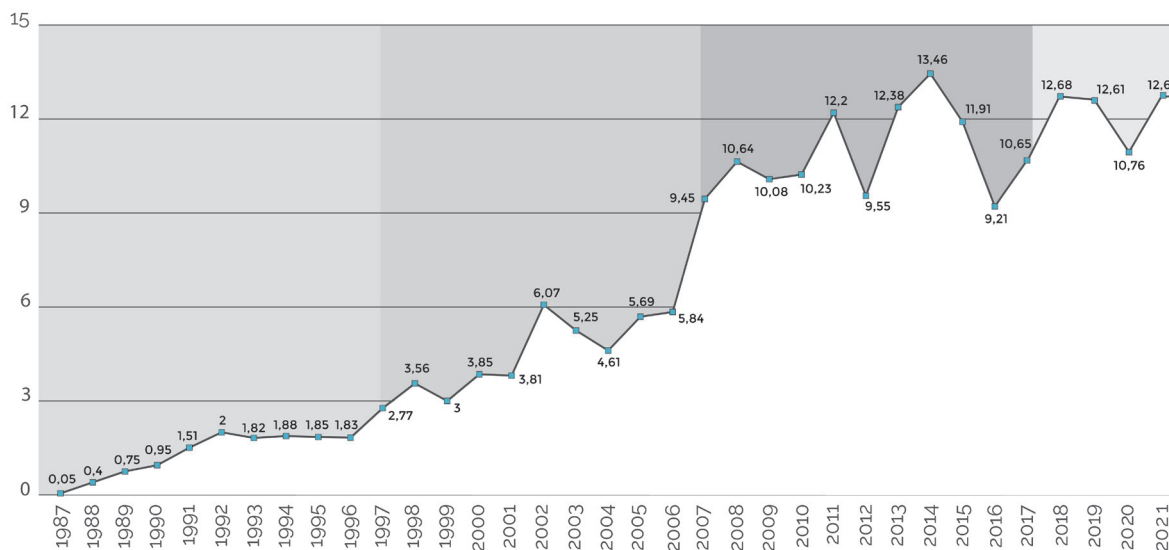- CONTRACTS WITH INDUSTRY
- TOTAL INCOME FROM PROJECTS
- TOTAL COMPETITIVE PROJECTS
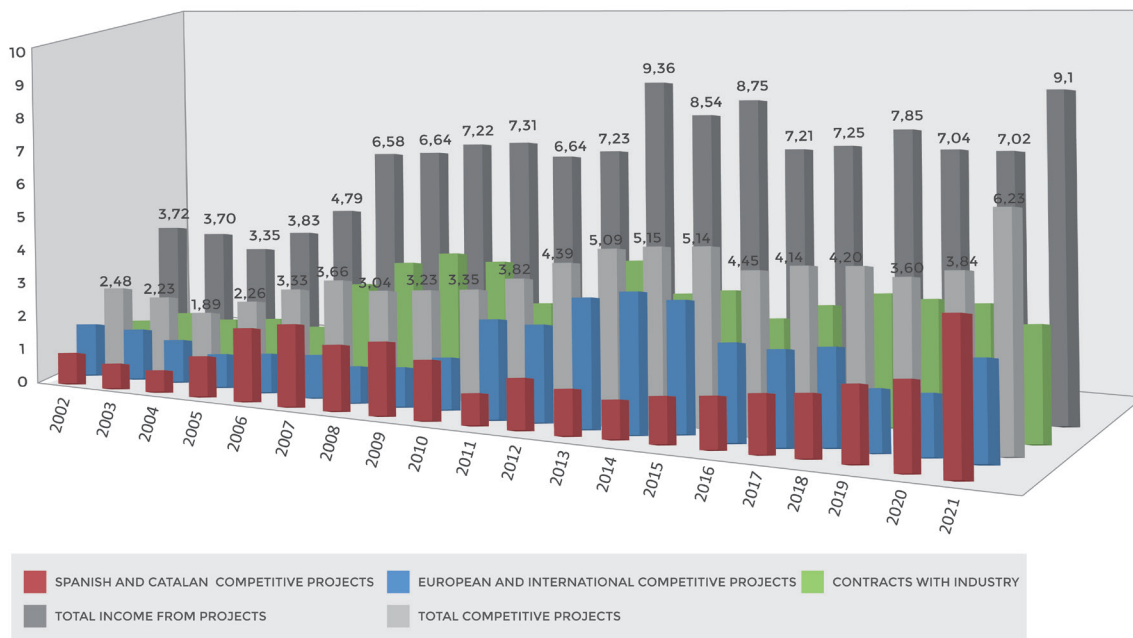
Evolution of Annual income (1987-2021)

*Data: Feb 2022 (Pending audit status)

in M€

Split of Annual income (2011-2021)

in M€

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SPANISH AND CATALAN COMPETITIVE PROJECTS	0,93	1,53	1,34	1,06	1,23	1,47	1,66	1,68	1,89	2,14	3,7
EUROPEAN AND INTERNATIONAL COMPETITIVE PROJECTS	2,89	2,86	3,75	4,09	3,92	2,98	2,47	2,51	1,71	1,7	2,53
CONTRACTS WITH INDUSTRY	2,82	2,84	4,27	3,39	3,61	2,75	3,11	3,66	3,44	3,18	2,78
CONFERENCES AND COURSES	1,66	0,35	1,37	3,50	1,71	0,78	1,86	1,98	2,15	0,95	0,97
FINANCIAL REVENUES	0,47	0,91	0,57	0,26	0,18	0,14	0,08	0,05	0,07	0,06	0,14
GRANT GENCAT	0,57	0,53	0,47	0,47	0,47	0,47	0,67	2,12	2,12	2,12	2,16
OTHERS	2,86	0,53	0,61	0,69	0,79	0,62	0,80	0,68	1,23	0,61	0,4

Governing Bodies

Governing Council

President

Hon. Mr. Jordi Puigneró
Minister of Vicepresidency, Digital Policies and Territory (Government of Catalonia)

Representing Catalan Government

Mr. Isidre Gavín
Secretary for Infrastructure and Mobility (Government of Catalonia)

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

Ms. Natàlia Mas Guix
Director-General for Industry (Government of Catalonia)

Vice-President

Dr. Eugenio Oñate
Full Professor (UPC · BarcelonaTech)

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

President

Dr. Eugenio Oñate
Full Professor
(UPC · BarcelonaTech)

Members

Mr. Xavier Baulies
Department of Digital Policies and Territory (Government of Catalonia)

Mr. Daniel Marco
Department of Digital Policies and Territory (Government of Catalonia)

Dr. Jordi Llorca
Vice-Rector for Research (UPC · BarcelonaTech)

Dr. Climent Molins
Vice-Rector for Transformation, Innovation and Entrepreneurship (UPC · BarcelonaTech)

Dr. Àlvar Vinacua
Vice-Rector for Digital Strategy (UPC · BarcelonaTech)

Dr. Pedro Diez
UPC · BarcelonaTech

Dr. Gabriel Bugeda
UPC · BarcelonaTech

Dr. Xavier Sànchez-Vila
Director of DECA (UPC · BarcelonaTech)

Dr. Ernest Bladé
In representation of Flumen

Dr. Lluís Rovira
CERCA Institute (Agency for the Research Centres of Catalonia)

Mr. Jordi Aguasca
ACCIÓ – Agency for Business Competitiveness (Government of Catalonia)

Dr. Cecilia Soriano
UNESCO

Scientific Advisory Council

The Advisory Scientific Council (ASC) 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. JAVIER BONET
Greenwich University, UK

Prof. MANUEL CASTELEIRO (†)
A Coruña University, Spain

Prof. FRANCISCO CHINESTA
ENSAM Paris, France

Prof. LAURA DE LORENZIS
ETH Zurich, Switzerland

Prof. JOSEF EBERHARDSTEINER
Vienna University, Austria

Prof. PÄR JONSEN
Lulea University, Sweden

Prof. MICHAEL KLEIBER
Academy of Sciences, Poland

Prof. RAINALD LOHNER
George Mason University, USA

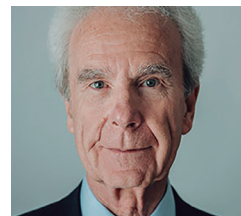**Prof. MANOLIS PAPADRAKAKIS** National Technical Univ., Athens, Greece

Prof. UMBERTO PEREGO
Politecnico di Milano, Italy

Prof. SIMONA PEROTTO
Politecnico di Milano, Italy

Prof. EKEHARD RAMM
Stuttgart University, Germany

Prof. BERNHARD SCHREFLER
Padova University, Italy

Prof. KAREN VEROY
Eindhoven University, The Netherlands

Prof. ROLAND WUCHNER
Technical University of Braunschweig, Germany

Organization Chart

GOVERNING COUNCIL
Chair: Jordi Puigneró

EXECUTIVE COUNCIL
Chair: Eugenio Oñate

SCIENTIFIC ADVISORY COUNCIL
Chair: Peter Wriggers

MANAGING BOARD

GENERAL DIRECTOR
Eugenio Oñate

SCIENTIFIC DIRECTOR
Pedro Díez

PROJECT DEVELOPMENT DIRECTOR
Fernando Salazar

INSTITUTIONAL RELATIONS DIRECTOR
Gabriel Bugeda

MANAGING DIRECTOR
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

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

Credible Data-driven Models
Leader - Pedro Díez

Kratos Multiphysics
Leader - Riccardo Rossi

Innovative Algorithms for Fast Accurate Computing
Leader - Antonio Huerta

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

Administration

ACCOUNTANCY AND FINANCES
Leader - Mª Carmen Linares

COMMUNICATION
Leader - Laura Bermúdez

CONGRESS BUREAU
Leader - Mar Santiago

HUMAN RESOURCES
Leader - Montserrat Martínez

POST-GRADUATE TRAINING
Leader - Lelia Zielonka

PRE-AWARD UNIT
Leader - Fernando Salazar

PROJECT MANAGEMENT
Leader - Sandra Pérez

PUBLICATIONS
Leader - MªJesús Samper

SYSTEMS
Leader - Miguel Alonso

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

CIMNE Staff

This is the list of all persons who collaborate with CIMNE at <u>December 31st 2021</u>

Research and Technology Development

FULL RESEARCH PROFESSORS
Carmen Andrade
Carlos Agelet de Saracibar
Eduardo Alonso
Irene Arias
Marino Arroyo
Santiago Badia
Álex H. Barbat
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

ASSOCIATE RESEARCH PROFESSORS
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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
Núria Pinyol
Javier Príncipe
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Pavel Ryzhakov
Fernando Salazar
Borja Serván
Francisco Zárate

ASSISTANT RESEARCH PROFESSORS
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Guillermo Casas
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Ignasi de Pouplana
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Alessandro Franci
Matteo Giacomini
José Manuel González
Joaquín A. Hernández
Julio M. Martí
Enrique Ortega
Fermín Otero
Jordi Pons
Marcelo Raschi
Eduardo Soudah
Rubén Zorrilla

POST DOCS
Gabriel Barbat
Ramón Barboza
Guillem Barroso
Miguel Calpe
Giancarlo Ciccionofri
David Codony
Alejandro Cornejo
Juan Marcelo Giménez
Laura González
Hauke Gravenkamp
Benedetto Grillone
Joaquín Irazábal
Gerard Laguna
Lluís Monforte
Alba Muixí
David Roca
Mario A. Salgado
Muhammad Awais
Shafique
Daniel Tarragó
Erdem Toprak
Francesc Verdugo
David J. Vicente
Rubén Zorrilla

STAFF SCIENTISTS
Pedro Arnau
Abel Coll
Stoyan Danov
Alessandra Di Mariano
Eloi Gabaldón
José M. González
Javier Mora
Melba Navarro
Jacques Périaux
Fernando Rastellini
Ramón Ribó
Ramón O. Salomón
Cecilia Soriano
Pere-Andreu Ubach

RESEARCH ENGINEERS
Diego Eugenio Aguilera
Barbara Alcayde
Laura Almunia
Clara Alvarado
Ferran Arrufat
Esther Blanco
José Manuel Broto
Alberto Burgos
Jordi Carbonell
Jesús Carbajosa
Marc Carnicero
Fabiola Cavaliere
Alexis Cid
Martí Coma
André Conde
Jesús Conde
Francesc Contreras
Óscar De Coss
Gaia Di Carluccio
Enrique Escolano
Alessandro Fraccica
Óscar A. Fruitós
Javier Gárate
Luis Miguel García
Javier Garrido
Francesc Gasparín
Luis Antônio Gonçalves
Mohammad Hashemi
Irene Jaqués
Jordi Jiménez
Judith Landinez
Juan Salvador Latorre
Sergi Macian
Genís Majoral
África Marrero
Ignacio Martinez
Josep Mayós
Adrià Melendo
Arisleidy Mesa
Arash Moaven
Anna Monros

Research and Technology Development

RESEARCH ENGINEERS (cont.)

Gerard Mor
Carlos A. Moreira
Christina Nasika
Marc Núñez
Gonzalo Javier Olivares
Eugenio Oñate Hospital
Miguel A. Pasenau
Andrés Pastor
Gilbert Peffer
Maria Rosa Peyrau
Domingo Peñalver
Cristian Pérez
Daniel Pérez
Cristian Ponce
Ángel Diego Priegue
Ivan Puig
Junior Ramírez
Francisco Rodero
Carlos A. Roig
Alfonso Rodríguez
Jatnna A. Sánchez
Núria Sau
Pablo Leonel Sierra
Fernando A. Sossa
Marcos Sanz
Sergi Saurí
Javier Soraluce
Alberto Tena
Sergio Valero
Ignacio Valero
María Teresa Yubero
Claudio Zinggerling

RESEARCH STUDENTS

PhD Students

Matías Alonso
Hadi Bakhshan
Irene Berdugo
Ashutosh Bijalwan
Pau Blanco
María Jesús Bopp
Álvaro Borràs
Reza Bozorgpour
Zulkeefal Dar
Malik Dawi
Irene De Cubas
Danial Dehghan
Maria Montserrat Dolz
Arnau Fabra
Mariano T. Fernández
Oriol Frigola
Stephan Gahima
Agustina Giuliodori
Eduard Gómez
Joaquín González
Sthefania Grajales
Peiman Khadivipanah
Sheraz Ahmed Khan
Nadeem Kever
Sergio Jiménez
Florencia Lazzari
Sergio Ricardo López
Luan Malikoski
Edgar Alexis Martínez
Hossein Mohammadi
Aníbal Andrés Moncada
Samar Momin
Christian Narváez
Rafael Nazareth
Rafel Perelló
Saman Rahmani
Abdul Rauf

Mohammad Razavi
Iván Rivet
Gastón Sal
Aniol Sala
Sebastián Sandoval
Samra Sarwar
Babak Sayad
Laurence Henry Sigler
Nathalia Silva
Mehdi Slimani
Clara Soler
Alireza Taherzadeh
Francesc Turón
Henning Venghaus
Pablo Nicolas Wierna
Chengshun Shang
Davood Yazdani
Buse Yetisti
Wanchang Zhang

Master Students

Juan Sebastián Gómez
Roser Márquez

Undergraduate Students

Víctor Martínez
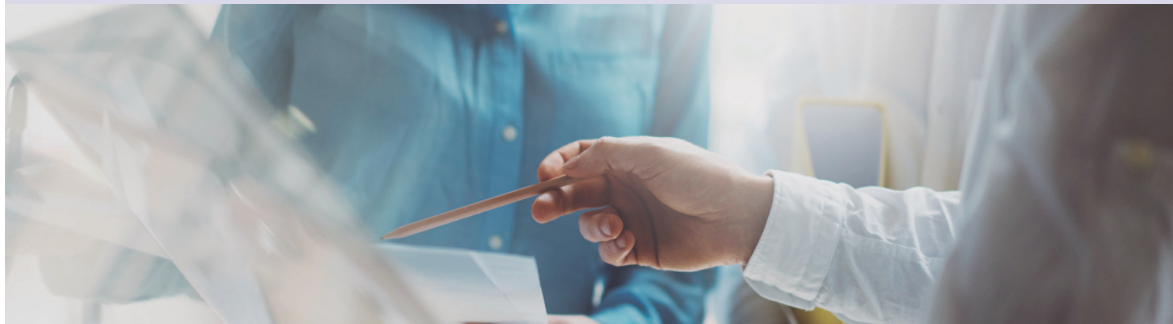Yago Mendoza
Sergio Olivares
Laura Santos

VISITING SCIENTISTS

CIMNE promotes the visits of academics and researchers from around the world. Visiting Scientists at CIMNE in 2021:

Visiting Scientists

Norberto Nigro
Jacques Periaux

Administration

GENERAL DIRECTOR
Eugenio Oñate

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)
Nuria Holgado
Elisabet Laya
Cristina Luque
Irene Martínez

COMMUNICATION
Laura Bermúdez

CONGRESS BUREAU
Maria del Mar Santiago
(Head of Unit)
Sami Amin
Alessio Bazzanella
Gemma Barberillo
Mónica Camanforte
Beatriz Rodríguez

DIRECTOR SECRETARY
Maria Rotger
Lelia Zlelionka

HUMAN RESOURCES
Irene Latorre
Leticia Chico

PROJECT MANAGEMENT
Sandra Pérez
(Head of Unit)
Marina de la Cruz
Francisco de la Rosa
Alicia Pallarés
Jon Rodríguez
Mahavir Singh

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)
Miquel Comas
Aitor Lázaro
Oscar Ruiz

TECHNICAL STAFF
Lisa Jane Grace
Andreu Marí
Javier Tous

TECHNOLOGY TRANSFER
Jordi Jiménez
Javier Marcipar
Eugenio Oñate Hospital
Sergio Otero

Where we are

Photos: C1 Building at Campus Nord UPC Barcelona

Headquarters

B0 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 m^2 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 m^2 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

CIMNE Premises

Apart from CIMNE's headquarters, located in Barcelona, CIMNE has six other branches: four premises in Spain (Castelldefels, Lleida, Madrid and Terrassa) and two legal offices around the world (US and Latin America).

The worldwide presence of the research centre is also represented by the 30 Aulas CIMNE (Joint Labs with universities all around the world).

CIMNE-USA
(Washington DC)

México (4)

Cuba (2)

Guatemala (1)

El Salvador (1)

Colombia (3)

Perú (1)

Brasil (4)

CIMNE-Latin America
(Santa Fe)

Chile (3)

Argentina (5)

- ■ CIMNE HEADQUARTERS
- ■ CIMNE PREMISES
- ● AULAS CIMNE (NUMBER IN BRACKETS)

Spain (6)

BARCELONA

Premises in Spain

CIMNE - Terrassa

CIMNE offices in Terrassa (Barcelona, Spain) opened in 2001. The premises cover an area of 150m^2 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 1,500m^2 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 Sept-ember 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 Eurotrading building, besides the Cappont Campus of the University of Lleida (UdL). The 130 m² office is surrounded by more than 30 companies from different sectors in the same building and the proximity to the University of Lleida gives CIMNE Lleida a strategic position.

Director: J. Cipriano

Address
Eurotrading Building
Pere de Cabrera, 16, 2G
25002 Lleida
Tel: +34 873 991 354 / +34 873 991 737

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
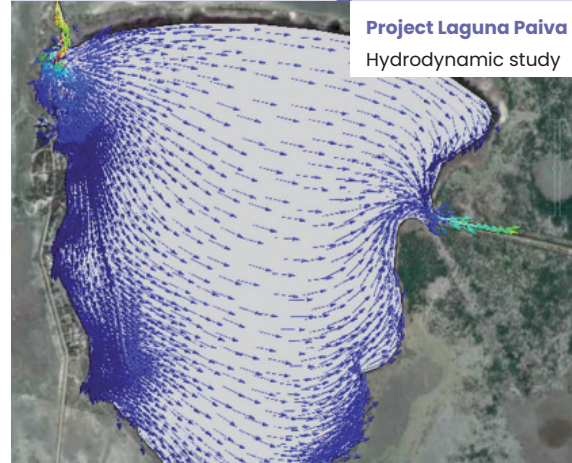
CIMNE is represented in Latin America by the CIMNE Iberoamérica Foundation (CIMNE Iber).

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.

México (4)
Cuba (2)
El Salvador (1)
Guatemala (1)
Colombia (3)
Perú (1)
Chile (3)
Spain (6)
Brasil (4)
Argentina (5)

TOTAL: **30** AULAS CIMNE

Argentina	⦿⦿⦿⦿⦿
Brazil	⦿⦿⦿⦿
Chile	⦿⦿⦿
Colombia	⦿⦿⦿
Cuba	⦿⦿
El Salvador	⦿
Guatemala	⦿
Mexico	⦿⦿⦿⦿
Peru	⦿
Spain	⦿⦿⦿⦿⦿⦿
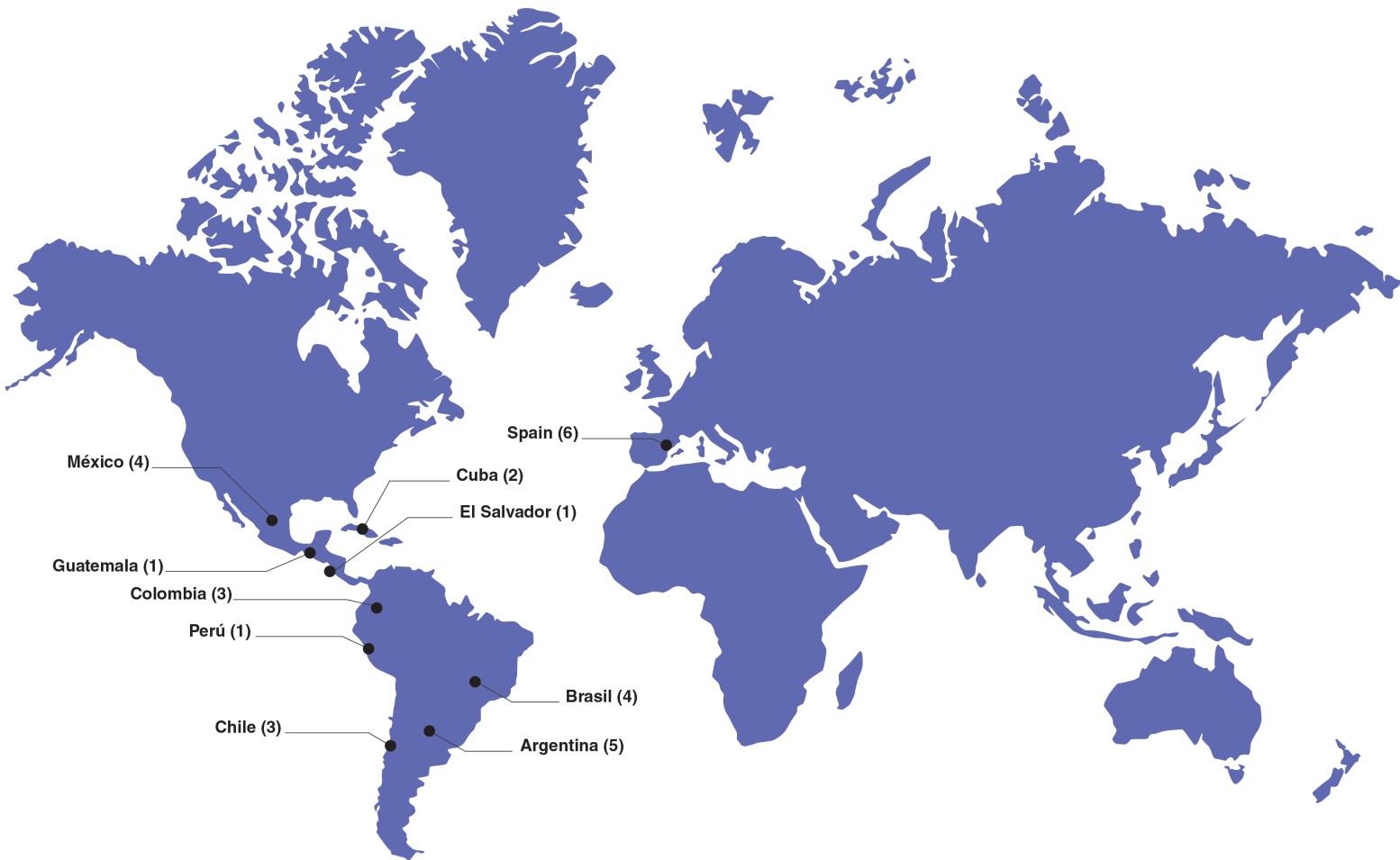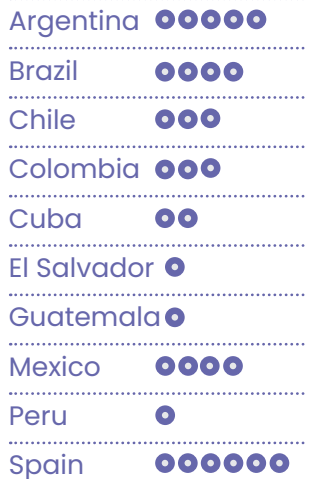
Aulas CIMNE

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.

AULA FICH – CIMNE (Argentina)

Universidad Nacional del Litoral
Director: Gerardo Franck
Created on: October 2002
Activity: Applications of numerical methods to problems related to water resources, mechanical and computer engineering.

AULA ITBA – CIMNE (Argentina)

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

AULA UNER – CIMNE (Argentina)

Universidad Nacional de Entre Ríos
Director: José Di Paolo
Created on: March 2013
Activity: Applications of numerical methods to problems related to Bioengineering.

AULA UNSA – CIMNE (Argentina)

Universidad Nacional de Salta
Director: Sergio Oller
Created on: April 2008
Activity: Development of computer models for application in civil engineering.

AULA FACET – CIMNE (Argentina)

Universidad Nacional de Tucumán
Director: Eduardo Martel
Created on: November 2002
Activity: Development of computational models of bridges (degradation and repair mechanisms).

AULA FEMEC – CIMNE (Brazil)

Universidad Federal de Uberlândia
Director: Gilmar Guimarães
Created on: April 2004
Activity: Forming process applications, structural design and biomechanics.

AULA Infralab – CIMNE (Brazil)

Universidade de Brasília
Director: Márcio Muniz
Created on: 2016
Activity: Applications of numerical methods in engineering problems

AULA IFSP – CIMNE (Brazil)

Instituto Federal de Educaçao, Ciência e Tecnologia de Sao Paulo
Director: Clayton dos Santos
Created on: July 2009
Activity: Applications of numerical methods in engineering problems in forming processes, solid mechanics and biomechanics.

AULA IFG – CIMNE (Brazil)

Instituto Federal de Educaçao, Ciência e Tecnologia de Goiás
Director: Écio Naves
Created on: October 2018
Activity: Applications of numerical methods in engineering problems.

AULA DIMEC – CIMNE (Chile)

Universidad Técnica Federico Santa María
Director: Franco Perazzo
Created on: 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 on: 2019
Activity: Applications of numerical methods to problems in Engineering.

AULA PUCV (Chile)

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

AULA UNC – CIMNE (Colombia)

Universidad Nacional de Colombia
Director: Jairo Andrés Paredes
Created on: June 2005
Activity: Numerical methods applied to civil engineering.

AULA UNIMAR – CIMNE (Colombia)

Universidad Mariana de Colombia
Director: Diego Valencia
Created on: May 2018
Activity: Structural analysis.

AULA UNIANDES – CIMNE (Colombia)

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

AULA UCI – CIMNE (Cuba)

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

AULA UCLV – CIMNE (Cuba)

Centro de Investigación de métodos computacionales y numéricos en la ingeniería. Universidad Central de las Villas
Director: Carlos Recarey
Created on: July 2003
Activity: Modelling and analysis of structures and grounds to the application of numerical methods.

AULA UCA – CIMNE (El Salvador)

Universidad Centroamericana "José Simeón Cañas" UCA
Director: Mauricio Pohl
Created on: February 2010
Activity: Civil eng. applications and multi objective optimization and applications.

AULA UMG – CIMNE (Guatemala)

Universidad Mariano Gálvez
Director: Rolando Torres
Created on: February 2011
Activity: Development of computer models for application in civil engineering.

AULA CIMAT – CIMNE (Mexico)

Centro de Investigaciones en Matemáticas
Director: Salvador Botello
Created on: June 2006
Activity: Applied mathematics, numerical methods, engineering and statistical analysis.

AULA UGTO – CIMNE (Mexico)

Universidad de Guanajuato
Director: Gerardo Valdés
Created on: January 2002
Activity: Civil engineering applications and multi objective optimization and applications.

AULA MORELIA – CIMNE (Mexico)

Universidad Michoacana de San Nicolás de Hidalgo
Director: Francisco Domínguez
Created on: October 2015
Activity: Civil, mechanic and electric engineering.

AULA TEC – CIMNE (Mexico)

Instituto Tecnológico de Monterrey
Director: Juan Álvarez
Created on: 2021

AULA PUCP – CIMNE (Peru)

Universidad Católica de Perú
Director: Rosendo Franco
Created on: April 2009
Activity: Modelling and analysis of structures and grounds to the application of numerical methods.

AULA ESEIAAT – CIMNE (Spain)

UPC · BarcelonaTech Terrassa
Director: Óscar Fruitós
Created on: April 2007
Activity: Industrial and aeronautical engineering

AULA EST – CIMNE (Spain)

Escola d'Enginyeria de Barcelona Est
Director: Daniel Di Capua
Created on: July 2017
Activity: Development of numerical methods in industrial and civil engineering.
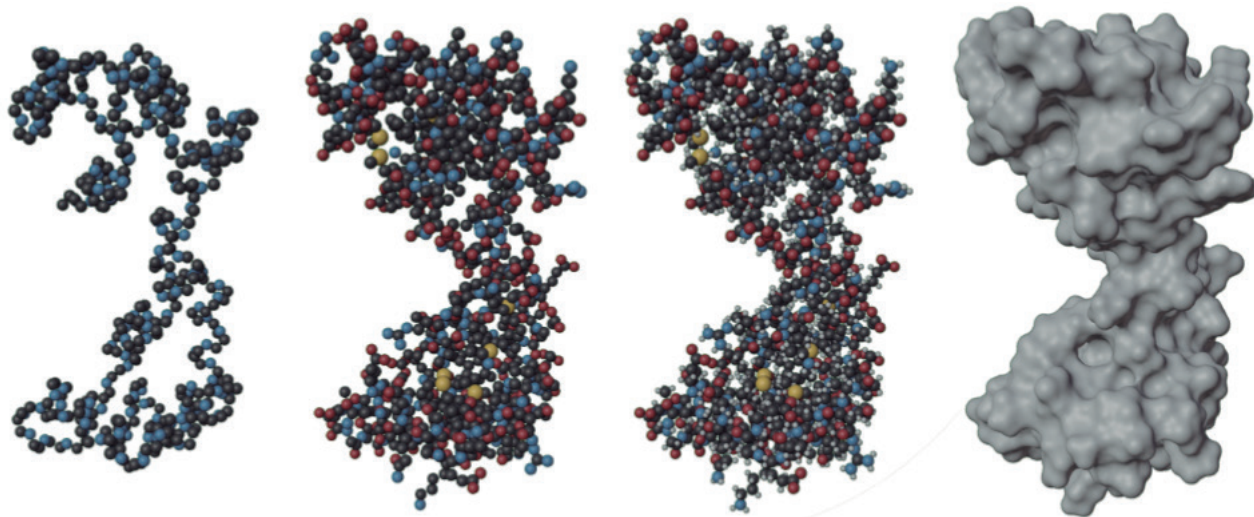
CAM Proteine in the 3D Space

AULA ETSINO – CIMNE (Spain)

Universidad Politécnica De Cartagena
Director: José Gutiérrez
Created on: May 2018
Activity: Development of numerical naval engineering.

AULA FNB – CIMNE (Spain)

Facultad de Náutica de Barcelona
Director: Julio García
Created on: 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 on: May 2010
Activity: Applications of numerical methods in civil engineering.

AULA ETS Ingenieros Industriales UPM – CIMNE (Spain)

Unversidad Politécnica de Madrid (UPM)
Director: Jorge Rodríguez-Chueca
Created in February 2021
Activity: Development and applications of numerical methods in aliviar engineering
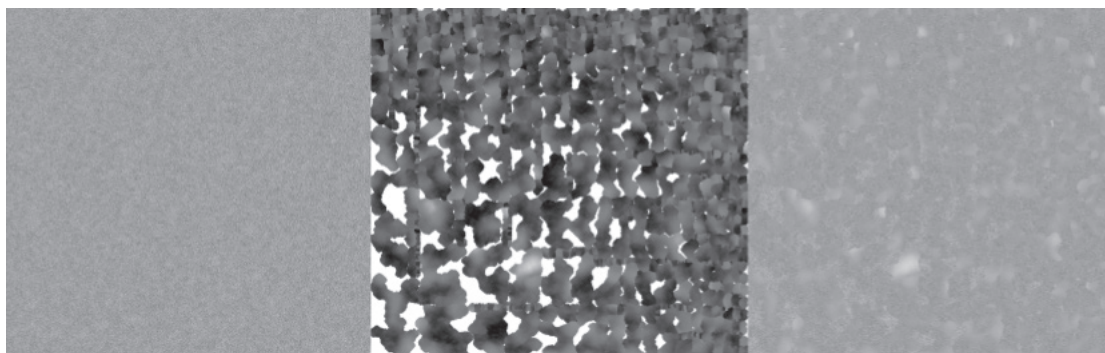
CAM Proteine (relief)

Research

CIMNE, Centre of Excellence Severo Ochoa

EXCELENCIA SEVERO OCHOA

The International Centre for Numericael 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).

With this action, the Ministry of Science, Innovation and Universities aims to promote high-impact research carried out in the R&D centres of Spain.

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:

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

BUILDING, ENERGY AND ENVIRONMENT
PI: Jordi Cipriano

DISASTER RISK AND RESILIENCE
PI: Liliana Carreño

GEOMECHANICS
PI: Marcos Arroyo

HYDROGEOLOGY
PI: Xavier Sànchez-Vila

MACHINE LEARNING IN CIVIL ENGINEERING
PI: Fernando Salazar

RIVER DYNAMICS AND HYDROLOGIC ENGINEERING (FLUMEN INSTITUTE)
PI: Ernest Bladé

STRUCTURAL MECHANICS
PI: Eugenio Oñate

COMPUTATIONAL MATERIALS DESIGN & ANALYSIS

COMPUTATIONAL DESIGN & ANALYSIS OF ENGINEERING METAMATERIALS
PI: Xavier Oliver

MECHANICS OF ELECTROACTIVE MATERIALS
PI: Irene Arias

SOFT AND LIVING MATERIAL INTERFACES
PI: Marino Arroyo

ENGINEERING MECHANICS AND PROCESSES

BIO-MEDICAL ENGINEERING
PI: Eduardo Soudah

FLUID MECHANICS
PI: Ramon Codina

INDUSTRIAL MANUFACTURING PROCESSES
PIs: Michele Chiumenti and Miguel Cervera

INNOVATION SUPPORT AND TECHNOLOGY TRANSFER

INFORMATION AND COMMUNICATION TECHNOLOGY
PIs: Ángel Priegue and Jordi Jiménez

PRE AND POST PROCESSING
PI: Abel Coll

VALORIZATION OF RESEARCH AND TECHNOLOGY TRANSFER
PI: Jordi Jiménez

INNOVATIVE ALGORITHMS AND HPC TECHNIQUES

CREDIBLE DATA-DRIVEN MODELS
PI: Pedro Díez

KRATOS MULTIPHYSICS
PI: Riccardo Rossi

INNOVATIVE ALGORITHMS FOR FAST ACCURATE COMPUTING
PI: Antonio Huerta

LARGE SCALE SCIENTIFIC COMPUTING
PI: Santiago Badia

TRANSPORT

AERONAUTICS
PI: Jordi Pons

CENIT - INNOVATION IN TRANSPORT
PI: Sergi Saurí

NAVAL AND MARINE ENGINEERING
PI: Borja Serván

Building, Energy and Environment

The Building Energy and Environment Group (BEE Group) is an autonomous department of the International Centre for Numerical Methods in Engineering (CIMNE) involving over 15 researchers (Physics, Engineering, ICT, Environmental Science 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 EUROTRADE building in Lleida.

Biodigester

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
Development of technologies to maximize impact of more efficient electricity consumption, optimize use of renewable at the same scale for use when demand does peak. The solutions take data driven models to manage user behavior according to energy generation through monitoring, analysis and validation of Demand Response algorithms.

Energy empowerment and user behavior.
PI: Stoyan Danov
Development of data driven user behavior models with the aim of defining the occupancy and user activity pattern to improve the quality of information provision to empower citizens to participate more actively in their energy expenses.

Big Data analytics for energy efficiency in buildings.
PI: Jordi Carbonell
Development of data driven models to get insights of the energy performance of huge amounts of buildings in real operation conditions: energy simulation, energy management practices, web services and monitoring devices in real buildings.

Bio-digesters. PI: Jaime Martí
Knowledge transfer since 2001 on design, implementation, installation and monitoring of domestic and industrial bio-digesters, adapted to simple technologies in cold climates, especially in the Andean region.

nZEBs and Energy positive living.
PI: Jordi Cipriano
Working actively to promote energy positive buildings and energy communities. BEE Group develops methodologies and technologies to facilitate the local energy transition at building and neighborhood levels.

Staff

**Jordi Cipriano
(Leader)**

José Manuel Broto
Jordi Carbonell
Francesc Contreras
Stoyan Danov

Eloi Gabaldón
Benedetto Grillone
Gerard Laguna
Florencia Lazzari

Selene Liverani
Jaime E. Martí
Edgar Alexis Martínez
Josep Mayós

Gerard Mor
Daniel Pérez
Joel Rosell

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 - 31/08/2022*

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 87.

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 has collaborated with several multilateral organizations and has been actively engaged in research, consulting, and capacity building activities in different world regions.
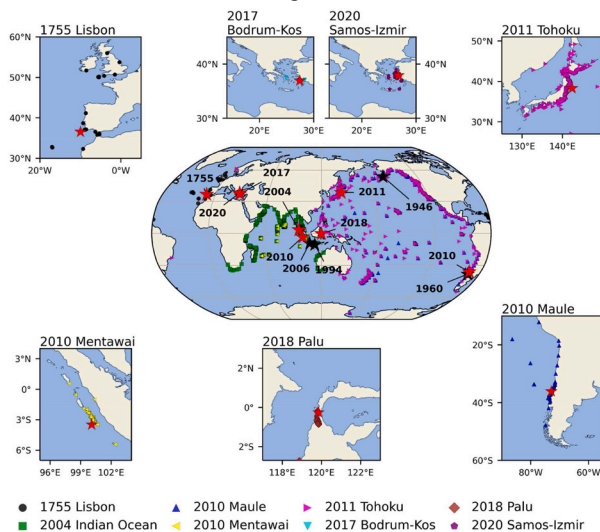
Tsunami risk communication and management: Contemporary gaps and challenges (Rafliana et al.,2021)

Research

Disaster risk assessments at different scales
PI: Liliana Carreño

Risk assessment with a comprehensive approach considering socio-economic and lack of resilience indicators. Development of tools for effective disaster risk management. These tools provide results for risk reduction, emergency attention and support different disaster risk management activities (Marulanda et al. 2020).

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

Global agendas encourage countries, regions, and cities to maintain efforts to reduce their disaster risk and improve their resilience. The development of indicators to perform such evaluations and perform progress monitoring helps communicate and apply an informed decision-making process (Lantada et al. 2020, Marulanda et al 2020).

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

Probabilistic catastrophe models provide required data for the structuring and design of financial protection strategies. The calibration and validation procedures for different components of the model, index selection, and customization of the models to fit the characteristics of portfolios impact the pricing and reliability of financial protection instruments.

Probabilistic Seismic Hazard Analysis
PI: Mario A. Salgado

Integration of the liquefaction analysis within the probabilistic seismic hazard framework. Typically, liquefaction analyses are performed for the maximum considered earthquake which selection tends to be highly subjective and does not provide a lot of information about its occurrence frequency. The use of an event-based approach to estimate the liquefaction hazard allows having a more comprehensive description of the problem and is very useful in environments where two or more seismic sources contribute to the overall hazard level.
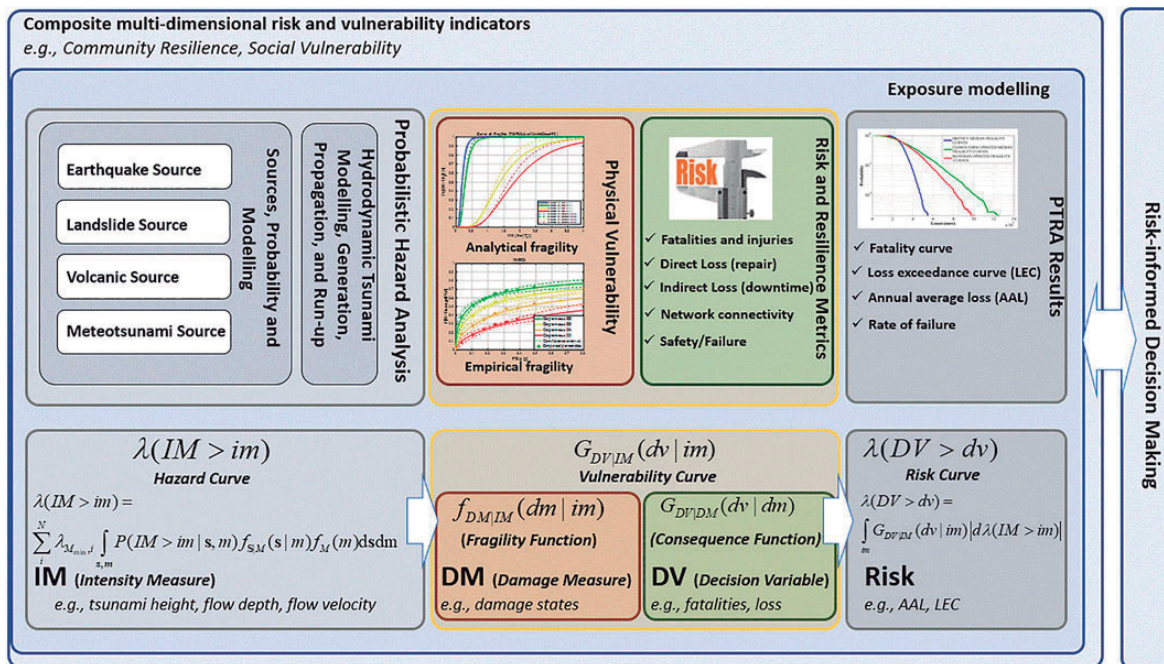
Probabilistic Tsunami Hazard and Risk Analysis: A Review of Research Gaps (Behrens et al.,2021)

On-going RTD Projects

PIPLATES (2020) - Plataforma de Predicció Territorial GENCAT - Tecnologies Digitals Avançades
Coordinator: CIMNE – *01/07/2020 - 30/06/2021*

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 Andrés Salgado
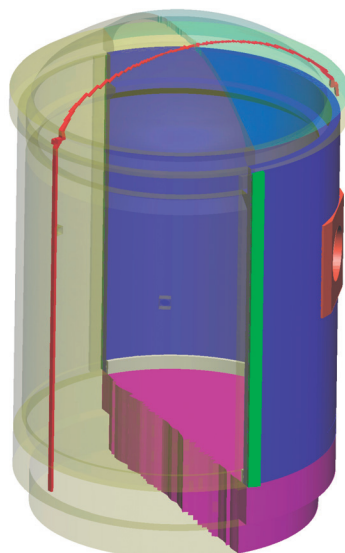
From "Analysis of the mock-up of a reactor containment building: Comparison with experimental results" (S. Reyes et al, 2020)

cimne.com/risk-resilience

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.

Achieving a proper balance among these aspects has been a permanent objective of the group over the years.

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**
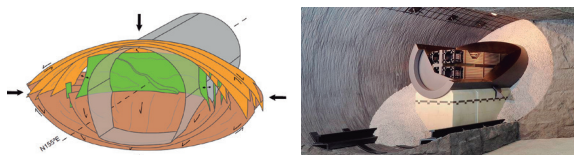
• Numerical analysis of large-scale infrastructure projects. **PI: Antonio Gens**
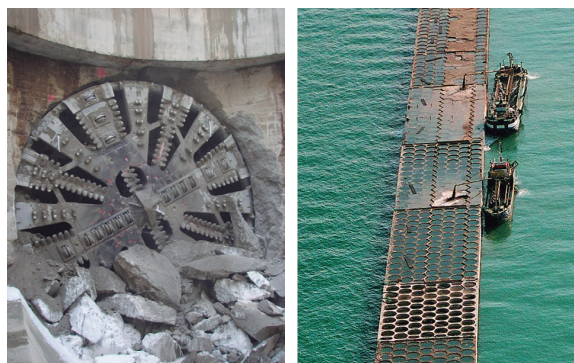
• DEM and PFEM modelling of penetration problems in Geomechanics. **PIs: Marcos Arroyo and Antonio Gens**
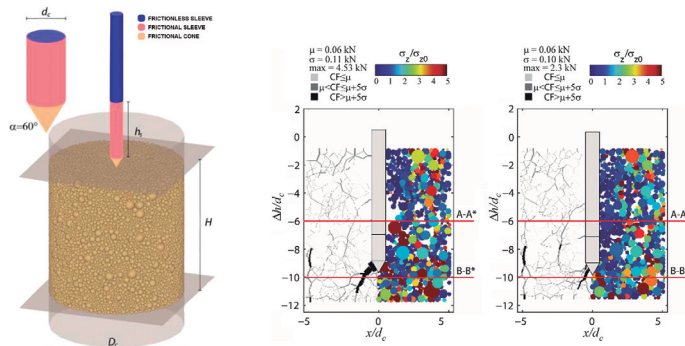
• Advance image analysis techniques for laboratory experiments in soils including large displacements and deformations. Measurements of degree of saturation based on infrared-images.
  PI: Núria M. Pinyol
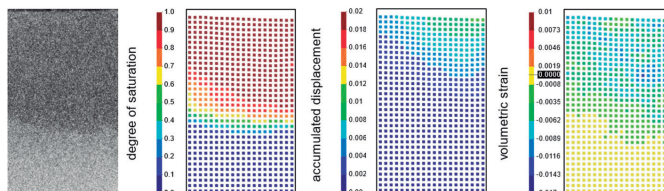
• Thermal-hydro-mechanical large deformation problems in porous media. Development of a Material Point Method open source code.
  PI: Núria M. Pinyol
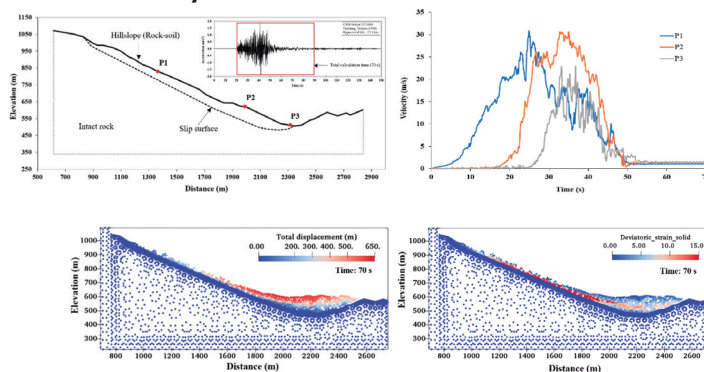
• Thermal accelerated seismic-induced-landslides.
• MPM modelling of flow-landslides.
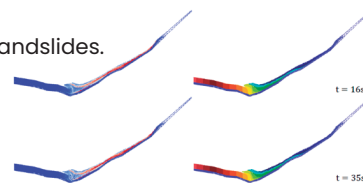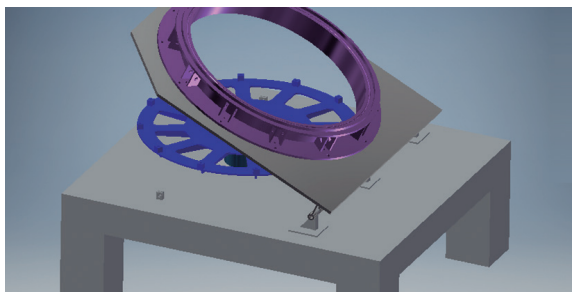
Design and construction of a geotechnical drum centrifuge for evaluating physical models subjected to large displacements and deformations

- Unsaturated Soil Mechanics. Experimental and theoretical advances. Application to embankments, dams and radioactive waste disposal. **PI: Eduardo Alonso.**
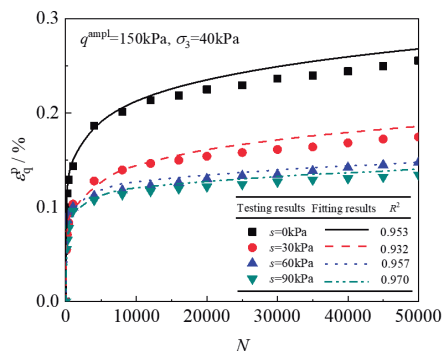
Comparison of measured deviatoric deformations in high number cyclic triaxial tests of unsaturated compacted samples and model predictions

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

Relative Humidity controlled device for testing coarse granular aggregates
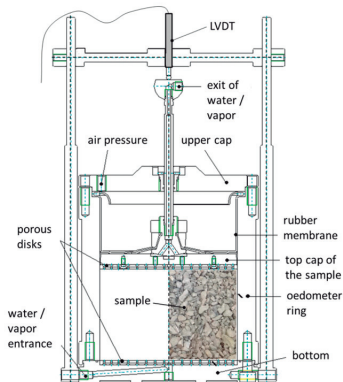
- Multi-scale experiments and analyses of geomaterials. **PIs: Enrique Romero** and **Laura González Blanco**

- 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**

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 anhy-dritic rocks - MCIU - Retos Investigación
Coordinator: CIMNE - *01/09/2019 - 31/08/2022*

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

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

Staff

Marcos Arroyo (Leader)

Matías Alonso	Judith Landinez	Alfonso Rodríguez
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Ramón Barboza	Antonio Lloret	Jatnna A. Sánchez
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Alessandra Di Mariano	Aníbal A. Moncada	Núria Sau
Alessandro Fraccica	Luis Monforte	Babak Sayad
Luis Miguel García	Sebastià Olivella	Fernando A. Sossa
Antonio Gens	Marta Pérez	Daniel Tarragó
Laura González	Núria M. Pinyol	Erdem Toprak
Irene Jaqués	Ivan Puig	Jean Vaunat
Peiman Khadivipanah	Anna Ramon	Davood Yazdani
	Mohammad Razavi	María Teresa Yubero

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 catalysed 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 tools.

Research

- **Analysis and implementation of coupled THM models for soils and rocks in the numerical modelling software CODE_BRIGHT. PI: Alfonso Rodríguez-Dono**
  This study provides a general numerical approach for predicting longitudinal deformation profiles using a coupled ViscoElastic-ViscoPlastic Strain-Softening (VEVPSS) model.
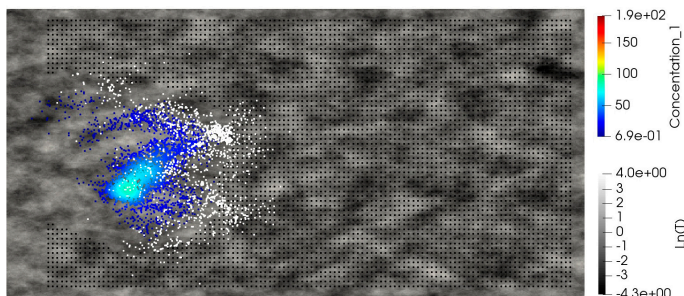
- **Environmental life cycle assessment for large-scale gold mining. PI: Alfonso Rodríguez-Dono**
  Using the life cycle assessment (LCA) software SimaPro, an assessment focused on large scale gold mining by heap leaching has been made, identifying that the processes that have the worst effects on the environment resulted to be processing, mainly, and leaching in second place.

- **Analysis of the controlling factors of seawater intrusion (SWI) in alluvial coastal aquifers and their coupling with submarine groundwater discharge (SGD). PI: Laura Martínez.**
  This investigation provides a framework for the coupled study of seawater intrusion and submarine groundwater discharge in alluvial coastal aquifers. It is based on a multidisciplinar and multiscale characterization and monitoring of an alluvial aquifer located at the mouth of a representative stream of the Maresme hydrological system.

This approach identified the aquifer hydraulic and geochemical controlling parameters and their impact on groundwater flow and more specifically, on the fate and transport of radioactive nuclides used to quantify submarine groundwater discharge. The analysis revealed the presence of a high reactive layer in the bottom of the aquifer charaterized by high U content and a huge geochemical activity in the mixing zone mainly represented by ion exchange.

Figure by Malik Dawi

Staff

Xavier Sànchez-Vila (Leader)
Allen Bateman
Marc Carnicero
Malik Dawi
Laura Martínez
Alfonso Rodríguez
Buse Yetisti

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 and water supply networks. However, these same techniques have been applied in the analysis of geomaterials such as railway ballast or landslides.

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, we are 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.

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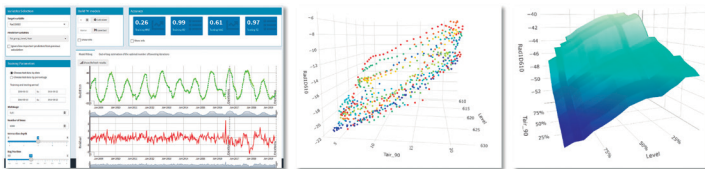
Software for dam safety assessment through ML: screenshots of PREDATOR/SOLDIER application

• New computational tools for reliability-based dam safety assessment: Use of ML models to support FEM analysis to predict dam response including uncertainty and risk analysis.
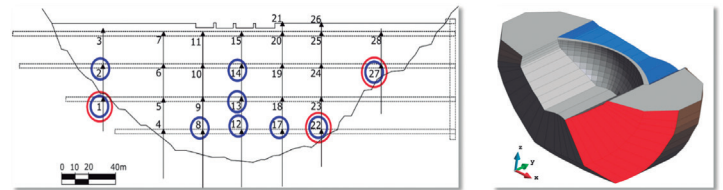
Anomaly detection in dams: example of monitoring network (left) and numerical model to simulate anomalous events (right)

• Leakage management in Water Distribution Networks (WDN): Development of data-driven classification models based on pressure monitoring data, combining ML techniques and graph theory for leakage detection and location.
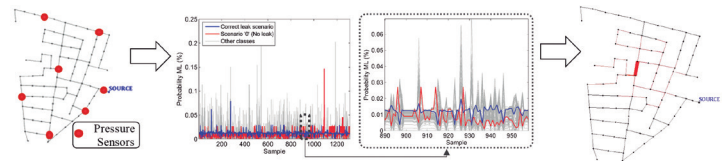
Leakage location in WDN through ML: pressure sensors location (left), probability analysis through classification ML model (middle) and map visualization of leak location results

• Analysis of hydraulic structures: Analysis of the hydraulic performance of dam spillways and bottom outlets combining numerical methods (PFEM, Free-Surface) and ML techniques.
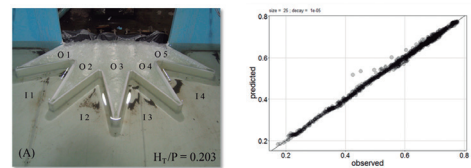
Spillway hydraulic performance: example of geometry (left) and relationship between observed and predicted values from ML models of discharge capacity

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Railway infrastructure simulation: ballast behavior simulation (left), calibration analysis (center) and railway infrastructure simulation (right)
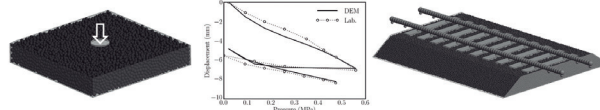
• Smart optimization of industrial processes: Support and optimization of rotational metal deformation design processes. Use of FEM-based Digital Twin framework combined with ML classification techniques.

Metal-forming processes analysis: industrial equipment (left) and GUI for process parametrization (right)

• 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.

• 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.
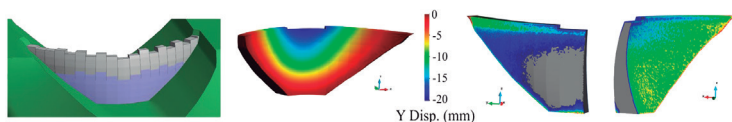
Concrete dam modelling: construction stage simulation (left), displacements field (center) and stresses field (right)

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

• 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.

• CFD analysis of hydraulic structures: Highly convergent spillways, stilling basin and drainage systems modelling.

• Analysis of railway track behavior: Simulation of railway infrastructures against climate change actions and evaluation of railway ballast response through DEM model.

• Numerical modelling of WDN: Development of numerical models for leakage simulation through advanced pressure-driven solvers.

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*

COFRE - Diseño Industrial de una COmpuerta Fusible REcuperable para la mejora de la Seguridad Hidrológica de las Presas
MCIU - Retos Colaboración: Proyectos I+D
Coordinator: VEMSA - *01/07/2018 - 31/12/2021*

PABLO - Prototipo de Aliviadero de BLOques en forma de cuña
MCIU - Retos Colaboración: Proyectos I+D
Coordinator: PREHORQUI - *01/07/2018 - 30/03/2022*

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)

André Conde

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

• **Reservoir dynamics:**

• Thermal and hydrodynamic behaviour
• Sediment and nutrients dynamics
• Reservoir impact on river dynamics. Corrective measures

• **Dam hydraulics:**
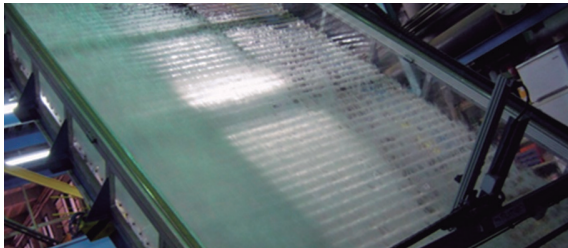
• New designs for spill-flows
• Spills over crest

• **Irrigation canals exploitation:**

• Automatic control algorithms
• Control structure and lateral storage

• **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 - CIAsifiCación 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*

Staff

Ernest Bladé (Leader)
Danial Dehgan Suraki
Gonzalo Olivares
Anaïs Ramos
Marcos Sanz
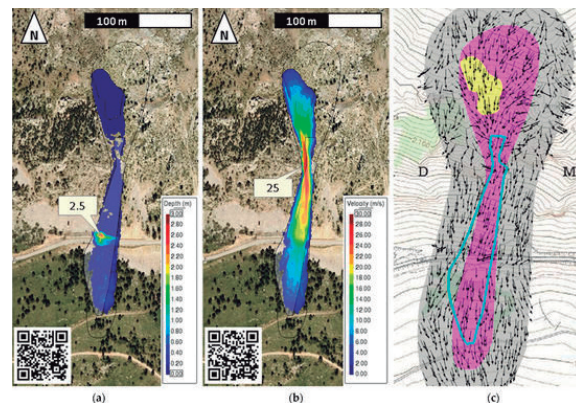
From the article "Reconstructing the Snow Avalanche of Coll de Pal 2018 (SE Pyrenees)" (M. Sanz et al.)

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.**
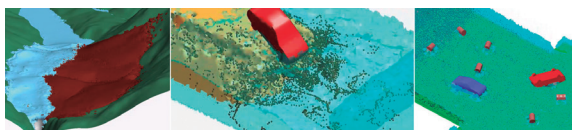
- **Finite element methods (FEM)** for nonlinear analysis of solids and structures with standard and composite materials. **PIs: X Martinez, F. Rastellini and E. Oñate.**

- **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.**
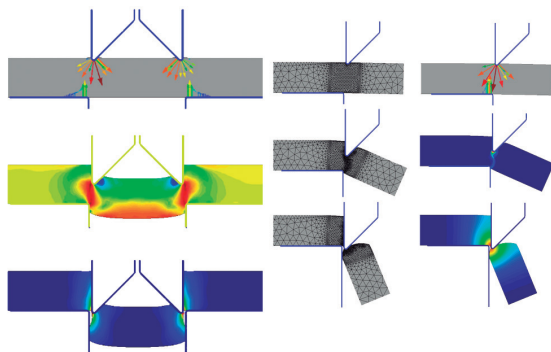
- **Discrete element methods (DEM)** for analysis of non-cohesive and cohesive materials. **PIs: M.A. Celigueta and E. Oñate.**
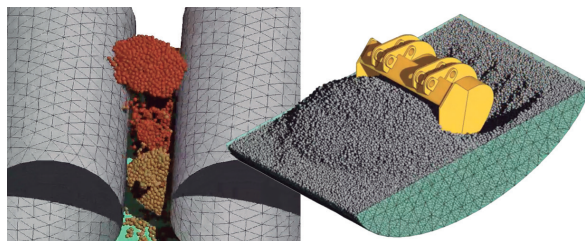
- **Coupling** of DEM, FEM and PFEM procedures. **PIs: M.A. Celigueta, G. Casas and I. Pouplana.**
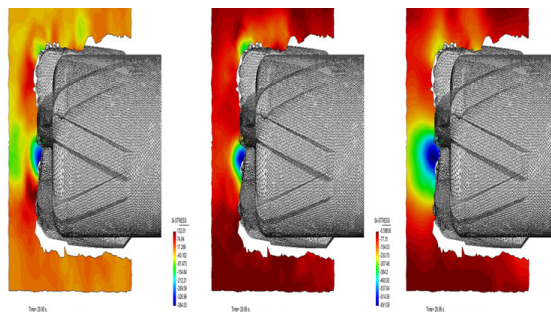
- **Finite elements** for analysis of plates and shells. **PIs: E. Oñate, F. Rastellini and J.M. González.**
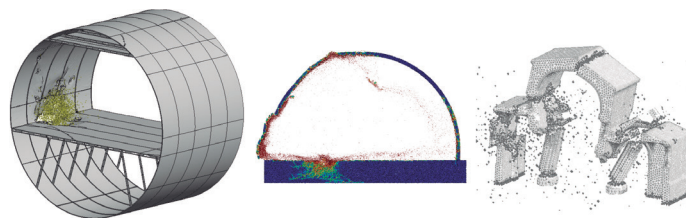
- **Innovative fatigue models accounting for coupled damage** and plasticity effects for analysis of structures under high, medium and low cycling loads with the FEM. **PIs: L. Barbu and E. Oñate.**

- **Modelling and simulation** of the melting and burning of objects in fire. **PIs: J. Martí and E. Oñate.**

- **Particle-based methods** for analysis of particulate flows. **PIs: S. Idelsohn, E. Oñate and G. Casas**

• **Numerical methods** for accurate and fast solution of problems in continuum and structural mechanics. **PIs: E. Oñate and I. de Pouplana.**

Staff

Eugenio Oñate **(Leader)**	Juan Salvador Latorre
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Ferran Arrufat	Xavier Martínez
Hadi Bakhshan	Javier Mora
Lucía Barbu	Rafael Nazareth
Gabriel Bugeda	Marc Núñez
Josep Maria Carbonell	Fermín Otero
Guillermo Casas	Gilbert Peffer
Miguel Ángel Celigueta	Siddharth Pitta
Alejandro Cornejo	Albert Puigferrat
Ignasi de Pouplana	Fernando Rastellini
Daniel Di Capua	Ramón Ribó
Maria Montserrat Dolz	Marc Rosell
Àlex Ferrer	Gonzalo Ruiz
Roberto M. Flores	Pavel Ryzhakov
Alessandro Franci	Aniol Sala
Juan Marcelo Giménez	Omar Salomón
Juan Sebastián Gómez	Chengshun Shang
Luis Antônio Gonçalves	Pablo L. Sierra
Joaquín González	Laurence Sigler
José Manuel González	Alireza Taherzadeh
Mohammad R. Hashemi	Francesc Turón
Fernando Hermosilla	Pere Andreu Ubach
Sergio Idelsohn	Ignacio Valero
Sergio Jiménez	Francisco Zárate
Joel Jurado	

On-going RTD Projects

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

AVINT - Estratègies de mecanitzat i predicció de la rugositat per a una integritat superficial òptima
ACCIÓ - Comunitat RIS3CAT Industries del Futur
Coordinator: CTM - *01/01/2018 - 20/03/2021*

ACASIAS - Advanced Concepts for Aero-Structures with Integrated Antennas and Sensors
EC - H2020
Coordinator: NLR - *01/06/2017 - 31/05/2021*

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*

Development of particle-based computational methods for predicting sand production and sand flow in oil wells. Exxon Mobil (Houston, USA)
PIs: M.A. Celigueta and E. Oñate - *2019-2021*

Development of finite element methods for analysis and design of new polymer fiber reinforced rebars for the building and construction sector - Saudi Aramco.
PIs: X. Martinez and E. Oñate - *2019-2022*

Espigó Infable-MMSC - Validation of inflatable breakwaters design for the intelligent protection of sandy beaches against erosion
AGAUR - Producte
Coordinator: CIMNE - *01/05/2019 - 01/02/2021*

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*

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 - 31/12/2022

Multiscale analysis of thermomechanical behaviour of granular materials
EC - MSCA-Marie Sklodowska-Curie Actions, H2020
PI: F. Zárate - *2019-2022*

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*

PRO2 - Ecosistema d'R+D+i per la implementació i adopció de la Fabricació Additiva /Impressió 3D a fabricació de productes indistrials i als processos industrials de producció
ACCIÓ - Comunitat RIS3CAT Llavor3D
Coordinator: LEITAT - *01/01/2018 - 20/03/2021*

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*

TRISTAN - New computational Tools for Reliability-based dam SafeTy AssessmeNt
MCIU - Retos Investigación
Coordinator: CIMNE
01/01/2019 - 31/09/2022
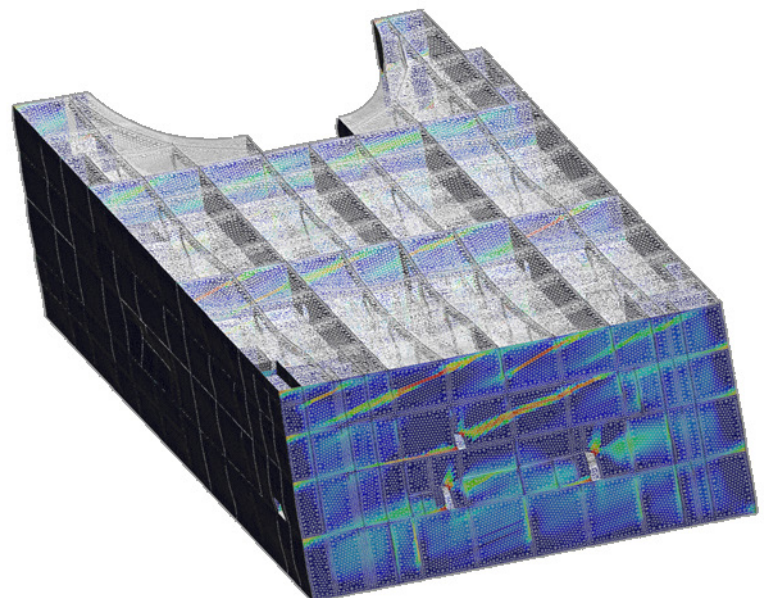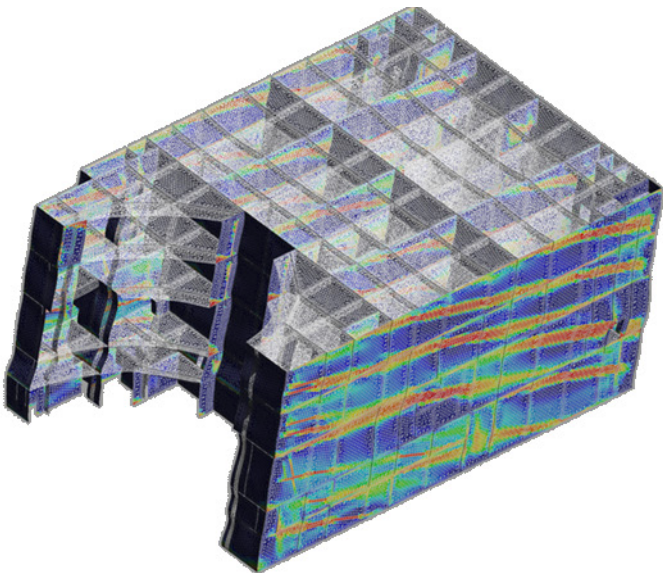
Computational Design & Analysis of Engineering Metamaterials

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**
  - **METACOUSTIC:** Development of new acoustic meta-materials (panels-liner)s for customized acoustic insulation.
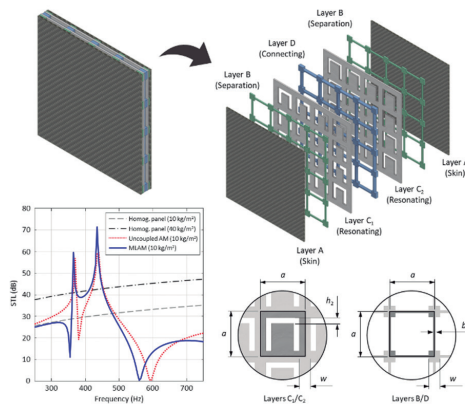
  - **VARTOP:** New methods for topology optimization in structural and thermal problems using variational-based techniques. Development of new mechanical meta-materials for shock absorbing.

  - **WPTE:** Design of new electromagnetic metamaterials for wireless power transfer (WPT) to be applied to energy exchange between fuel-powered and electrical vehicles.

- **High Performance Model Order Reduction methods (HPR-FE2) for industrial multiscale material modelling and design**
  - **HPR-FE2 PLUGIN:** New high-efficiency methods for taking multiscale model order to daily-live industrial applications.
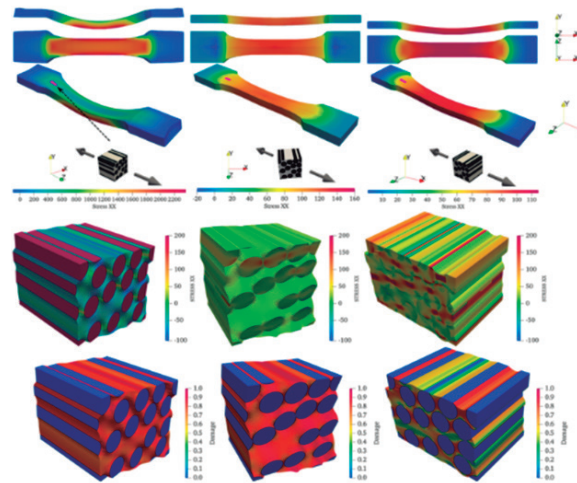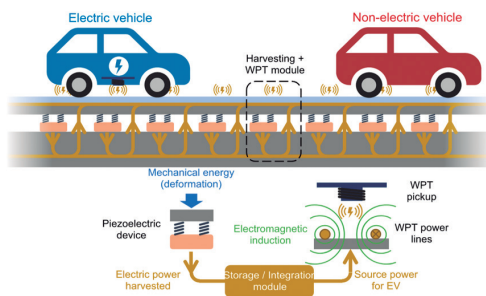
Staff

Xavier Oliver (Leader)
Juan Carlos Cante
Oriol Lloberas-Valls
Marcelo Raschi

David Roca
Gastón Sal-Anglada
Pablo Wierna
Daniel Yago

On-going RTD Projects

METACOUSTIC - Computational design and prototyping of acoustic metamaterials for target ambient noise reduction
EC - H2020
Coordinator: CIMNE - *01/11/2019-30/04/2021*

cimne.com/computational-metamaterials

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.** Develop 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, I. Arias.

- **Efficient numerical solution of high-order general electromechanics problems:** Development of 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. **PI: Irene Arias.**

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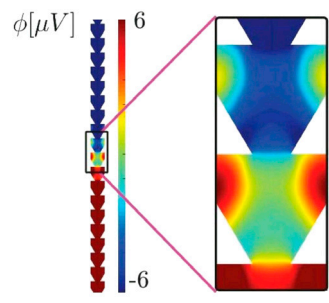
- **Flexoelectricity from first principles:** Development of electronic structure calculations of flexoelectric systems to establish a precise connection with continuum models both guiding the development of enriched models accounting for nanoscale effects and finite surface effects and characterizing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

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

- **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: A. Abdollahi, J. Barceló-Mercader, H. Mohammadi, I. Arias.**

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

- **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, Amir Abdollahi.**

Staff

Irene Arias (Leader)
David Codony
Hossein Mohammadi

Lifshitz-invariant flexoelectricity form

ϕ [V]   -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15
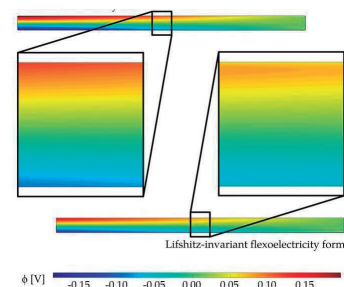
Soft and Living Material Interfaces

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

- **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.**
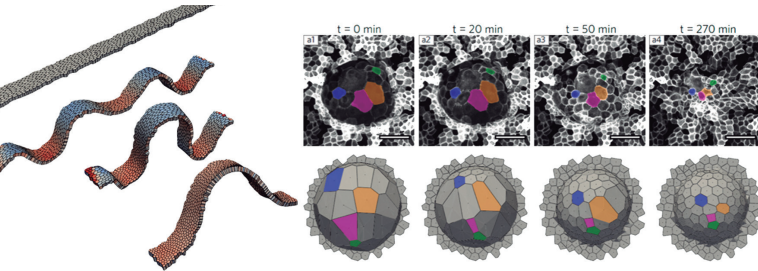
- **Mechanics of the cell envelope:** Development of theoretical and computational models to understand and quantify the mechanics of the cell envelope, and to develop biomimetic multifunctional systems based on the engineering principles of the cell envelope. **PI: Marino Arroyo.**

- **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.**

- **High-performance finite element library for interfacial problems:** Development of a high-performance finite element parallel library to model Multiphysics interfacial problems. **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)
Giancarlo Cicconofri
Jose Muñoz
Pau Blanco
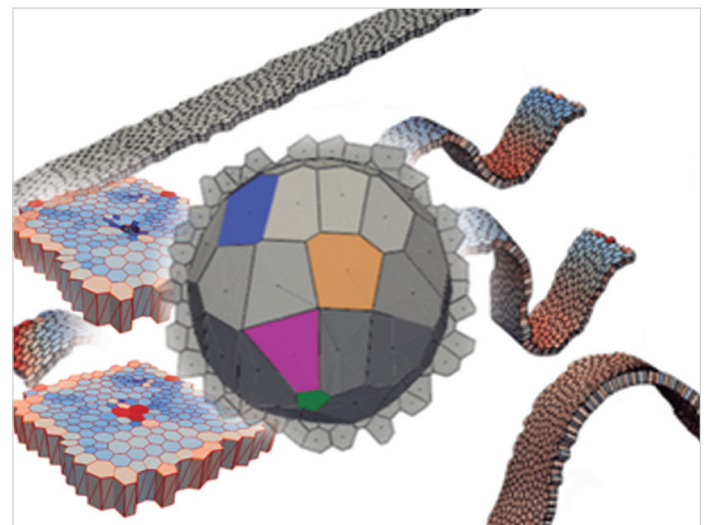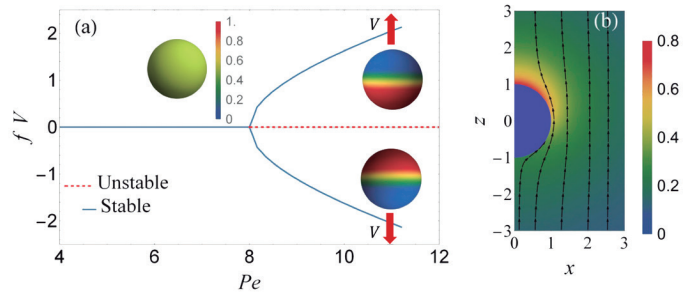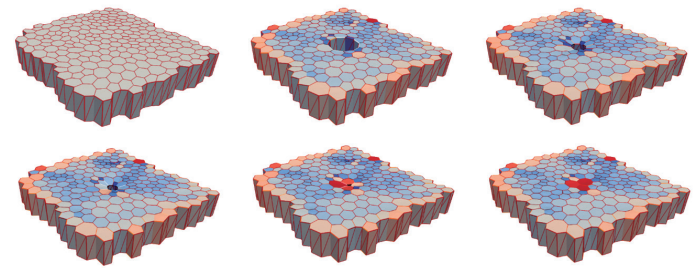
Bio-Medical Engineering

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 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. We aim at making patient care more personalized and secured. The group has a strong background in the cardiovascular, dental and respiratory areas.

At present, we are developing Augmented & Virtual reality methodologies for improving the healthcare system. We are applying augmented reality techniques for breast and liver surgeries. We have developed an API to couple Unity and KRATOS frameworks. This API is able to provide augmented real simulations. The group has a clear practical approach, and includes among its capabilities the development of customized user medical interfaces.

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.**
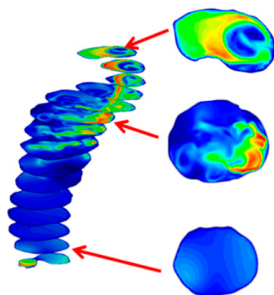
• Artificial Intelligence Methods: Combination of numerical simulations with machine learning techniques for different pathologies.
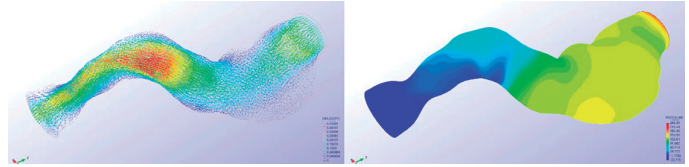
• Medical Device R&D: Medical devices for medical companies and physicians to improve their personalized designs. Innovative tools based on our numerical simulation technology to better design medical devices during the pre-prototype stage. **PIs:** **E. Soudah and J. A. Hernández.**
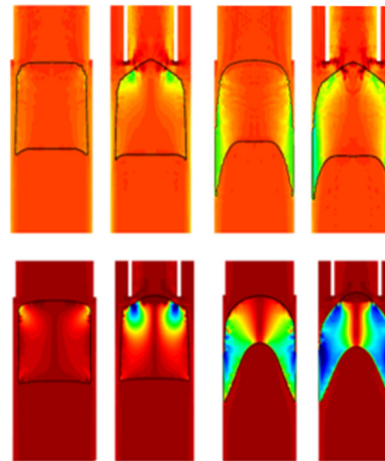
• Respiratory System: New solution for Obstructive Sleep Apnea treatment (OSAS). **PI:** **E. Soudah.**
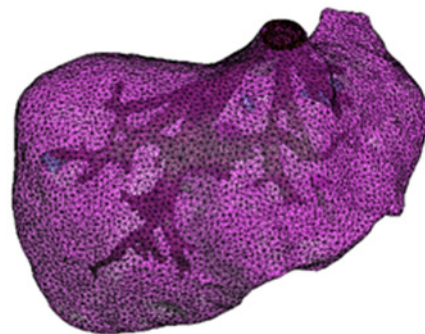
- **Image Processing & Modelling:** *Software solutions to automatically transform medical imaging to create a 3D digital models to help diagnostics, to virtually try treatments, and to automatically design optimal devices.* **PI:** **E. Soudah.**

- **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.**

Staff

Eduardo Soudah *(Leader)*
Óscar de Coss
Agustina Giuliodori
Joaquín A. Hernández
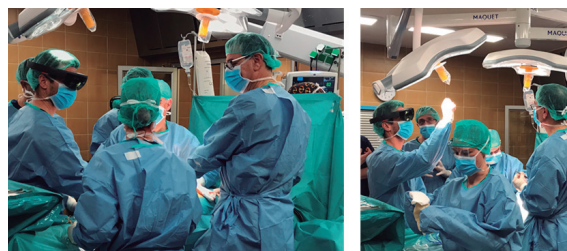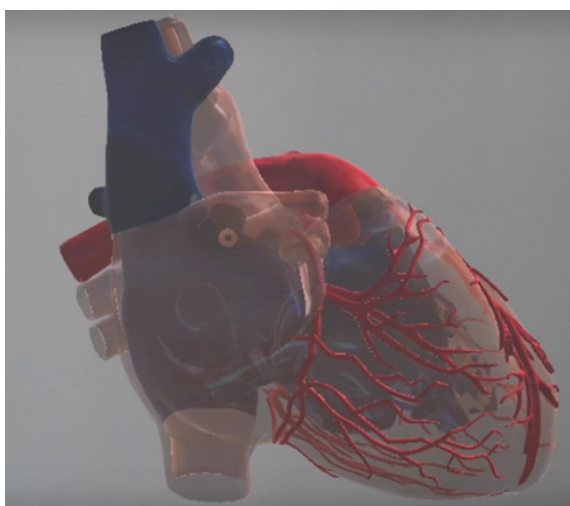
- **Augmented and Virtual Reality:** Interactive surgical communication platform based on augmented reality technology for clinical remote assistance in real time. **PI:** **E. Soudah.**

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. With applications to the simulation of railway generated sound. **PIs: R. Codina and J. Baiges**
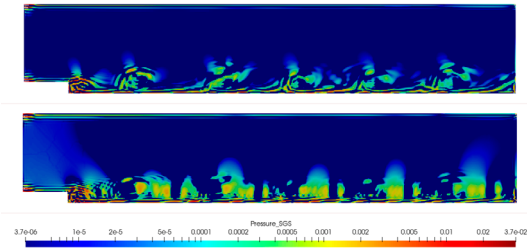
- **Topology optimization in fluid-structure interaction.** Finite strain cases which require a special treatment, and incompressible and nearly incompressible materials. **PIs: R. Codina and J. Baiges**

- **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

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*

Staff

Ramon Codina **(Leader)**	Sheraz Ahmed Khan
Joan Baiges	Ignacio Martínez
Zulkeefal Dar	Laura Moreno
Arnau Fabra	Saman Rahmani
Hauke Gravenkamp	Abdul Rauf
Francisco Javier Gual	

cimne.com/fluid-mechanics
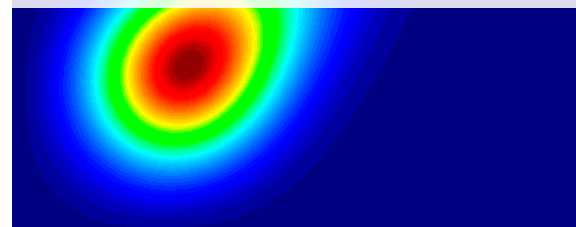
Industrial Manufacturing Processes

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.

COMET includes multiple classical and advanced elements formulations as well as a wide constitutive law library (viscoelasto-plasticity, small and large strain plasticity, damage models, etc).

Research

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

Temperature evolution
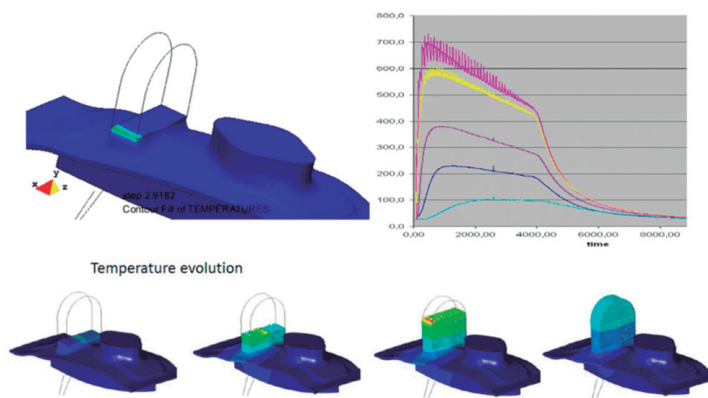
• **Constitutive Modeling and Computational Failure Mechanics.** New constitutive models appropriate for mechanical and civil engineering materials. These include isotropic and orthotropic plasticity models appropriate for metallic and polymeric industrial parts and components and damage models for civil engineering structures.

PIs: M.Cervera and M. Chiumenti

On-going projects

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

AVINT - Estratègies de mecanitzat i predicció de la rugositat per a una integritat superficial òptima (RIS-3CAT Industries del Futur)
ACCIÓ - Projectes col·laboratius recerca industrial i/o innovació
Coordinator: CTM
01/01/2018 - 20/03/2021

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

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

PRO2 - Impressió 3D a fabricació de productes industrials i als processos industrials de producció (Comunitat RIS3CAT Llavor3D)
ACCIÓ - Projectes col·laboratius recerca industrial i/o innovació
Coordinator: LEITAT
01/01/2018 - 20/03/2021

[FURTHER ONGOING PROJECTS - INDUSTRIAL MANUFACTURING PROCESSES]

PriMuS - Printing pattern based and MultiScale enhanced performance analysis of advanced Additive Manufacturing components
MCIU - Retos Investigación
Coordinator: CIMNE
01/09/2021 - 31/08/2024

SSeCoID - Stability and Sensitivity Methods for Flow Control and Industrial Design
EC-H2020 | 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 - 30/09/2022

TRANSPORT - Impressió 3D a la indústria del transport (Comunitat RIS3CAT Llavor3D)
ACCIÓ - Projectes col·laboratius recerca industrial i/o innovació
Coordinator: CIMNE
01/01/2018 - 20/03/2021

Staff

Miguel Cervera (Leader)
Michele Chiumenti (Leader)
Carlos Agelet de Saracibar
Gabriel Barbat
Jesús Conde
Narges Dialami
Óscar Fruitós
Carlos A. Moreira
Iván Rivet
Mehdi Slimani
Henning Venghaus
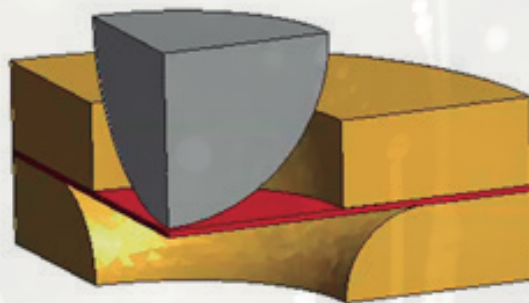
Credible Data-driven Models

The group aims at developing, implementing and analyzing models and methods accounting for their credibility, and assimilating data into the model. The credibility concept embraces three underlying ideas: control of the numerical accuracy (Verification), monitor the pertinence of the model (Validation) and account for the aleatoric nature of the systems analyzed (Uncertainty Quantification).

The data assimilation strategies are incorporating into the models the information contained in data from sensors, observations and other models. This is complementary to the Validation phase (via parameter identification) and strongly related to the Uncertainty Quantification.

The group has a proven track record in applying these tools and methods to diverse disciplines in applied sciences and engineering. In particular, some of the current active projects and research lines pertain to the field of Automotive Engineering, Geophysical Modelling, and Biomechanics (biometamaterials).

Research

- **Error assessment and adaptivity.** Development, analysis and implementation of numerical tools for assessing the error in solutions produced by Finite Element and Reduced Order Models. Mesh and model adaptivity to monitor the numerical accuracy. **PI: P. Díez.**
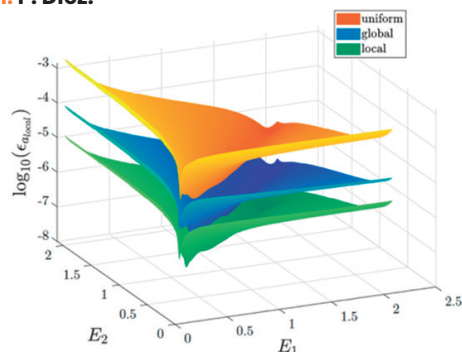
- **Data-driven Geophysical Modeling.** High-fidelity models of large-scale geophysical phenomena in the earth crust. Data assimilation and model updating. Bayesian approaches to inverse problems. **PI: S. Zlotnik.**

- **Data-driven Biomechanical Modeling.** Modeling and simulation of biomechanical devices and biosystems. Computational design of metamaterials for health care applications. **PI: A. García-González.**

- **Reduced-Order Models and Surrogate Models.** Intrusive and nonintrusive Reduced Order Models, using different numerical strategies accompanied by error control. Special insight in Proper Generalized Decomposition (PGD) and Proper Orthogonal Decomposition (POD). **PI: P. Díez.**

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)	Arash Moaven
Fabiola Cavaliere	Alba Muixí
Mariano Tomás Fernández	Christina Nasika
Matteo Giacomini	Wanchang Zhang
Stephan Gahima	Sergio Zlotnik

Innovative Algorithms for Fast Accurate Computing

Fast and accurate solution of computationally-demanding engineering problems is critical in daily industrial practice. Indeed, efficient strategies are needed to compute multiple queries of complex multi-physics and multi-disciplinary problems arising in parametric studies such as flow control, shape design and optimization, real-time monitoring of manufacturing processes and inverse analysis in medical imaging.

To contribute to these challenges the group exercises a comprehensive approach in the area of computational science and engineering, in order to develop new mathematical models and numerical methods to predict and quantify science and engineering problems. This implies combining concepts, methods and models of an interdisciplinary nature that include various disciplines such as mechanics, mathematics and computer science, among others.

Research

- **High-fidelity simulations of complex phenomena.** Development of high-order approximations (in particular, hybridizable discontinuous Galerkin) with exact geometric description (via NURBS-enhanced FEM) of engineering problems. **PIs: A. Huerta and M. Giacomini.**

- **Robust low-order solvers for large-scale problems.** Development of innovative finite volume strategies and integration in open-source libraries for fast computation of industrial problems. **PIs: A. Huerta and M. Giacomini.**
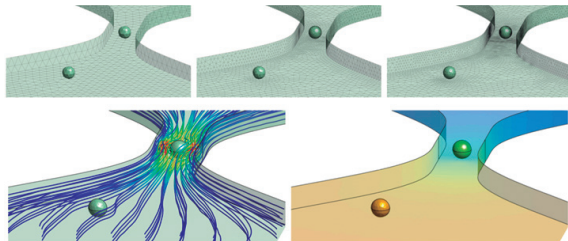
- **Reduced-order models for parametric studies.** Development of surrogate models (via proper ge-

neralized decomposition) for real-time solution of parametric problems. **PIs: A. Huerta and M. Giacomini.**
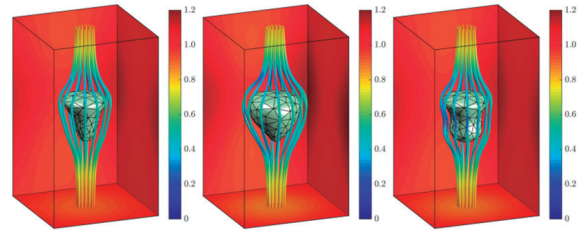
Credibility of computational engineering solutions. Development of certification techniques for reliable simulations with goal-oriented error control and adaptivity. **PI: A. Huerta.**

- **Open-source solutions for industrial problems.** Development of open-source software and application to fluid, solid, electromagnetics and multiphysics problems of industrial interest. **PIs: A. Huerta and M. Giacomini.**

On-going 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

Staff

Antonio Huerta
(Leader)

Guillem Barroso	Nadeem Kever
Álvaro Borràs	Luam Malikoski
Matteo Giacomini	Josep Serrate
Rafel Perelló	

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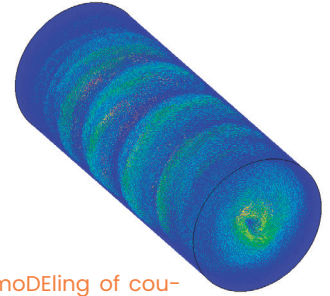
The Kratos Multiphysics group aims at the development of a global purpose research code integrating state-of-the art capabilities in multiple fields, with the explicit goal of allowing the simulation of complex multiphysics problems.

The group aims at the exploitation of High Performance Computing 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 collaboration with groups located at different locations 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

• **Developement of CFD models and other FEM technologies, including model order Reduction**Development of new solver capabilities within Kratos, and as a tools for the development of projects. This includes in particu ar the improvement of the existing capabilities for the solution of "embedded" CFD problems and the development of new real-time interactive solvers based on ROM.

• **Uncertainty Quantification (UQ) and Optimization Under Uncertainties (OUU):** Uncertainty Quantification studies the characterization and the reduction of uncertainties in problems where some variables of the system are not exactly known. Optimization Under Uncertainties aims at solving optimization problems by considering the aforementioned uncertainties in the objective function, constraints or parameters of the problem.

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*

ExaQUte - EXAscale Quantification of Uncertainties for Technology and Science Simulation
EC - H2020 (2014-2020)
Coordinator: CIMNE - *01/06/2018 - 31/05/2021*

EdgeTwins HPC - Bringing Digital Twins to the Edge for mass Industry 4.0 applications
EC - H2020 (2014-2020)- SC7-Secure societies
Coordinator: CIMNE - *01/06/2020 - 30/11/2021*

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

ExaQUte - EXAscale Quantification of Uncertainties for Technology and Science Simulation
EC-H2020 - Coordinator: BSC
01/06/2018 - 30/11/2021

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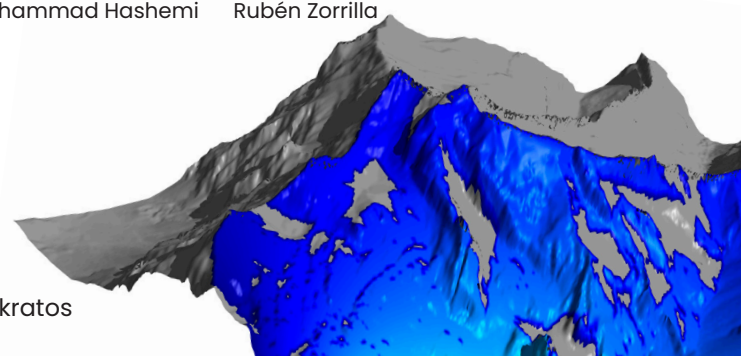*01/03/2021 - 29/02/2024*

Staff

Riccardo Rossi
(Leader)

Javier Gárate   Joaquín A. Hernández
Eduard Gómez   Carlos Roig
Muhammad Hashemi   Rubén Zorrilla

cimne.com/kratos

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 and discretisations:** 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.

- **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.
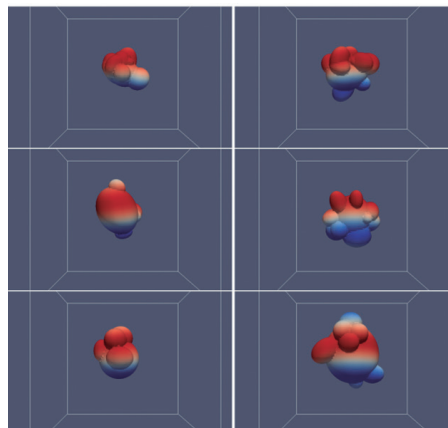
On-going RTD Projects

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*

ExaQUte - EXAscale Quantification of Uncertainties for Technology and Science Simulation
EC - H2020 (2014-2020)
Coordinator: CIMNE - *01/06/2018 - 31/05/2021*

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)
Jordi Manyer
Javier Príncipe

Francesc Verdugo
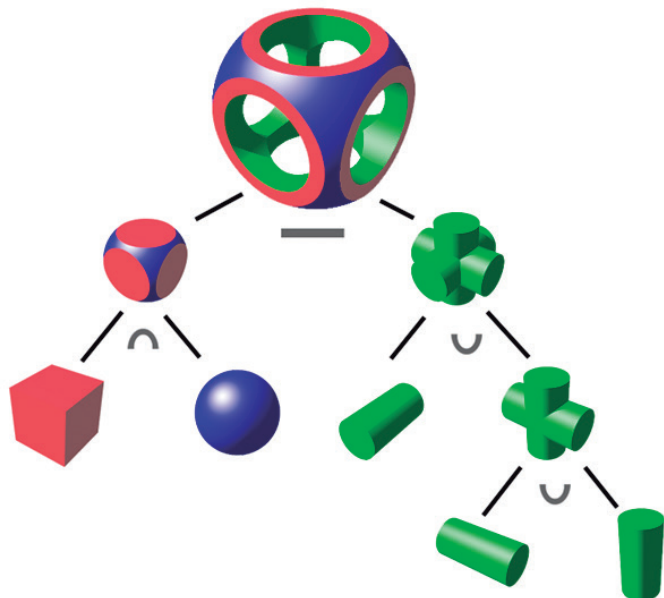
Aeronautics

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 sensing 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, J. Pons-Prats and O. Frigola.**

- **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**

Staff

Jordi Pons-Prats (Leader)	Martí Frigola
	Cristian Narváez
Martí Coma	Jacques Périaux
Roberto M. Flores	Enrique Ortega
Sergio González	Raúl Sáez
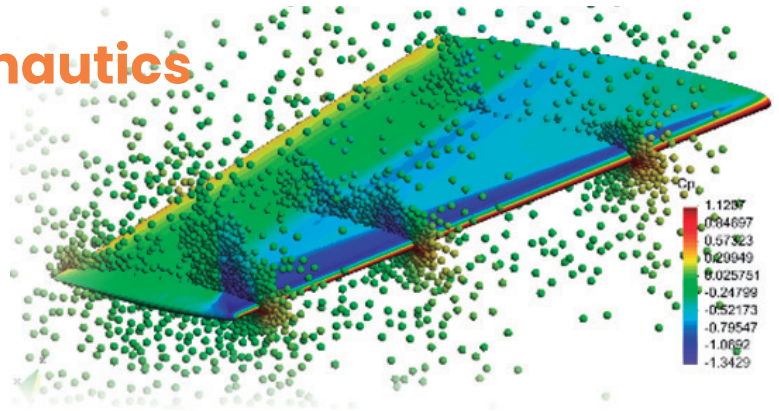
On-going RTD Projects

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

AVINT - Estratègies de mecanitzat i predicció de la rugositat per a una integritat superficial òptima
ACC1Ó - RIS3CAT
Coordinator: CTM - *01/07/2017 - 20/03/2021*

CityFlows -Decision-support system for pro-active crowd management of crowded urban spaces
EC- H2020 - SC4-Smart, green & integrated transport
Coordinator: AMS Institute - *01/01/2020 - 31/12/2021*

ExaQUte - EXAscale Quantification of Uncertainties for Technology and Science Simulation
EC- H2020 - Future & emerging technologies
Coordinator: CIMNE - *01/06/2018 - 31/05/2021*

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

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.

- **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.

Staff

Sergi Saurí (Leader)
Irene De Cubas
Javier Garrido
Francesc Gasparín
Maurici Hervas
Lisa Grace
África Marrero
Genis Majoral
Moisés Ortega
Andrés Reyes

Francisco Rodero
Paola K. Rodríguez
Muhammad Awais Shafique
Kristi Shalla
Samra Sarwar
Clara Soler
Guillermo Solina

On-going RTD Projects

CityFlows -Decision-support system for pro-active crowd management of crowded urban spaces
EC- H2020 - SC4-Smart, green & integrated transport
Coordinator: AMS Institute
01/01/2020 - 31/12/2021

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

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

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

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 and application of computational methods and computer aided design and verification tools on the following topics:

- Hydrodynamic analysis of vessels / optimum shape design methods for ships.
- Ship structures / composite materials / fluid-structure interaction effects.
- Offshore structures / fluid-structure interaction effects.
- Environmental problems in naval and marine engineering.
- Multidisciplinary problems in naval and marine engineering.
- Decision support systems in naval and marine engineering / wireless sensor networks / artificial intelligence technology.

Research

- **Development of technology for the massive application of composite materials in large marine structures.** The objective of this line is the development of computational tools to enable the design and assessment of large FRP marine structures.

- **Hydrodynamic analysis of vessels.** The current objective of this line is the development and application of advanced computational tools for the analysis and optimization of ship hulls.

- **Ship structures / fluid-structure interaction.** The current objective of this line is the development and application of advanced computational tools for the direct analysis of ship structures (including structural health monitoring solutions).

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*

NICESHIP - Desarrollo, validación y demostración de un algoritmo semilagrangiano para el análisis de la navegación en hielo de buques
MCIU - Retos Investigación
Coordinator: CIMNE - *01/01/2019 - 31/03/2022*

Staff

Borja Serván (Leader)

Irene Berdugo	Mohammad S. Eshagui
Reza Bozorgpour	Julio García-Espinosa
Miguel Calpe	Rafael Pacheco
Jonathan Colom	Andrés Pastor

Information and Communication Technology

The Information and Communication Technology Group of CIMNE specializes in research, development and innovation of new and disruptive technologies, applicable to multiple engineering areas.

The group activities aim to improve simulation tools, smart embedded systems, Artificial Intelligence (AI), IOT devices and GIS in order to develop Decision Support Systems (DSS), Prediction Systems and Cyber Physical Systems (CPS) for advancing knowledge and technology in engineering and applied sciences for different sectors: Industry5.0, SmartCities, Environment, Building, Transport, Health, etc.

Research

Computation and Information Technologies
(PI: J. Jiménez)

- 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

Staff

Ángel Priegue and Jordi Jiménez (Leaders)

Pedro A. Arnau
Laura Almunia
María Jesús Boop
Alberto Burgos
Alexis Cid
Eduard Escola

Sergi Macian
Andreu Marí
Javier Mora
Cristian Pérez
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*

CityFlows - Decision-support system for pro-active crowd management of crowded urban spaces
EC - H2020 - SC4-Smart, green & integrated transport
Coordinator: AMS Institute - *01/01/2020 - 31/12/2021*

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

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

COOSW - Transnational cooperation in Lab validation for SWAC, WEC and COOL STEAM devices harnessing the ocean energy
EC - ERA - NETS
Coordinator: CIMNE
01/06/2019 - 31/05/2022

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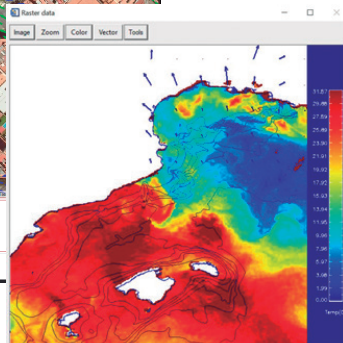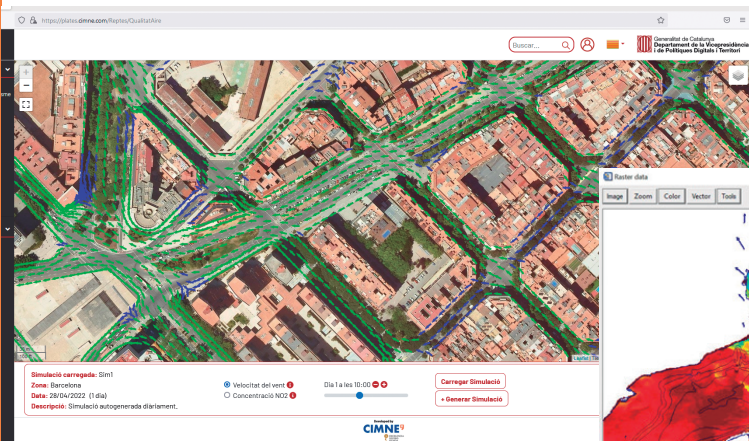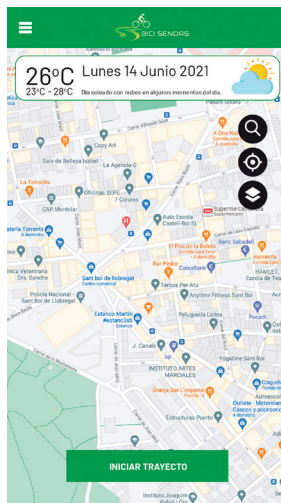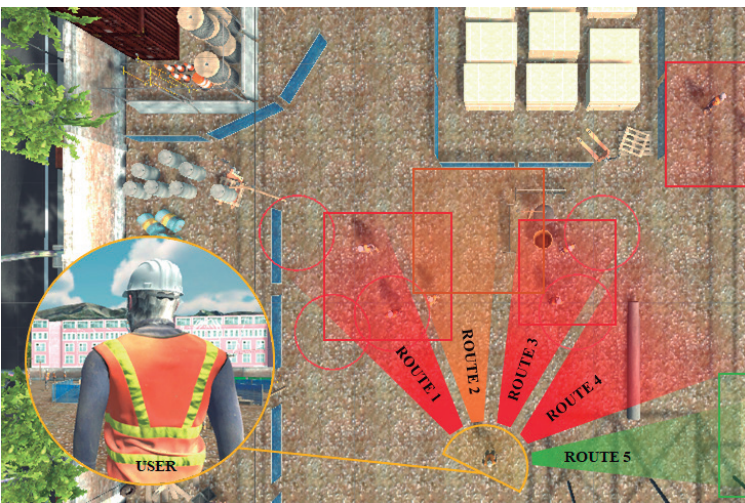
HAMELIN - Herramientas para adecuar y mejorar la gestión de plagas de insectos
EC- Interreg/POCTEFA
Coordinator: CIMNE
01/01/2019 - 31/01/2022

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

EUIN COAST - Preparación de la Propuesta HEU "COAST - Citizen Science for Global Coast Environmental"
MCIU - Europa Investigación
Coordinator: CIMNE - *01/11/2020 - 31/10/2022*

PAVIRE - Plataforma TIC para la Gestión del Estado del Pavimento y su influencia en el consumo con información cruzada del tipo de conducción
MCIU - Retos Colaboración: Proyectos I+D
Coordinator: COMSA
01/07/2018 - 30/06/2021

BIMIoTICa - Digitalización de los Procesos de Prevención de Riesgos Laborales en el Sector de la Construcción
MCIU - Retos Colaboración: Proyectos I+D
Coordinator: COMSA - *01/07/2018 - 31/12/2020*

GNLBlockchain - Implementación de un prototipo pre-industrial de ultracongelación utilizando GNL y desarrollo de herramientas de trazabilidad mediante el concepto Blockchain
MCIU - Retos Colaboración: Proyectos I+D
Coordinator: E4EFFICIENCY - *01/07/2018 -01/07/2018*

APoEmA - Aigua potable per a emplaçaments aïllats
AGAUR - Producte
Coordinator: CIMNE
23/07/2020 - 22/01/2022

PIPLATES - Plataforma de Predicció Territorial
GENCAT - Tecnologies Digitals Avançades (TDA)
Coordinator: CIMNE
01/07/2020 - 30/06/2022

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

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.
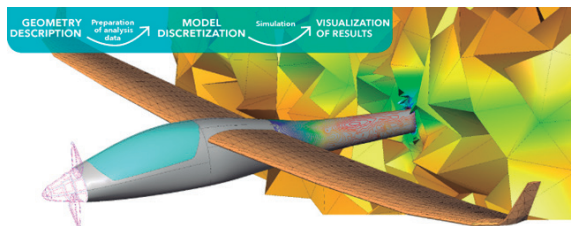
- **Mesh Generation. PI: A. Coll**
  Development and improvement of mesh generation tools for numerical simulations, covering the needs of all CIMNE groups devoted to numerical simulations, as well as the GiD users.
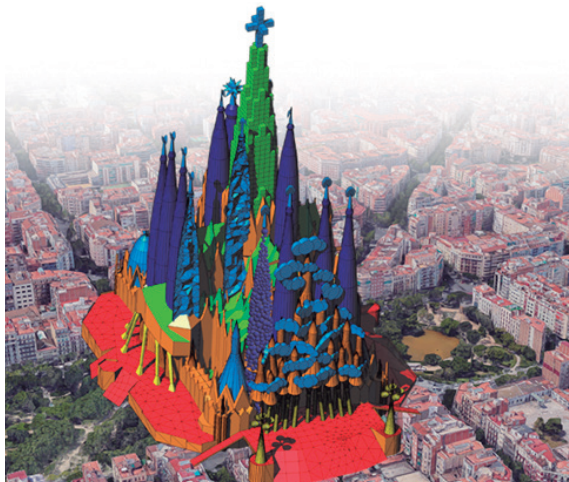
- **Postprocessing for numerical simulations. PI: M. Pasenau**
  Development of advanced postprocessing techniques for numerical simulations, specially for cases of huge distributed results focused on High Performance Computing (HPC) architectures.

- **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

ACASIAS - Advanced Concepts for Aero-Structures with Integrated Antennas and Sensors
EC - H2020 (2014-2020)
Coordinator: NLR - *01/06/2017 - 31/05/2021*

CityFlows - Decision-support system for pro-active crowd management of crowded urban spaces
EC - H2020 (2014-2020)
Coordinator: AMS Institute - *01/01/2020 - 31/12/2021*

Staff

Abel Coll (Leader)
Enrique Escolano
Javier Gárate
Adrià Melendo
Anna Monros

Miguel Pasenau
Maria Rosa Peyrau
Laura Santos
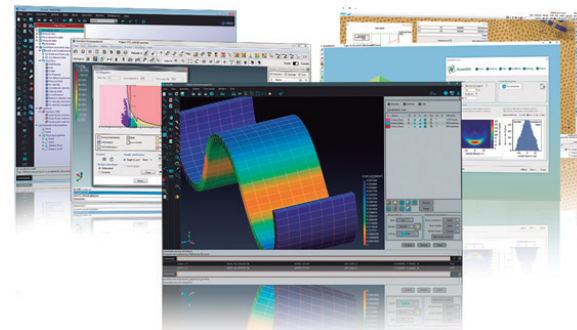
Valorization of Research and Technology Transfer

The Valorization of Research and Technology Transfer 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 Valorization of Research and Technology Transfer 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 the creators to distributors in the market. Two main tools are used by CIMNE for the technology transfer: Technology License agreements and creation and shareholding in spin-offs.

Staff

Jordi Jiménez (Leader)
Javier Marcipar

Eugenio Oñate Hospital
Sergio Otero
Ignacio Valero

New technologies under valorization process

• **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. It allows to become aware to make a more responsible consumption at a particular level and to generate data (big data) to obtain quantitative information at a macro level, in order to take better decisions and generate more efficient consumption strategies and policies.

• **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 needed to set-up large formworks in roads, bridge and buildings.

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PS-Bridge-1_viga_15.60	1.3
E_Alsina H33_15.00m	2.4
	2.4
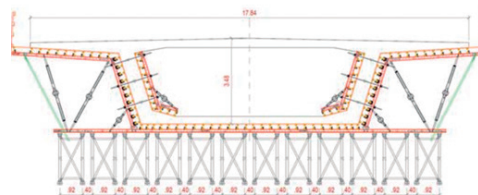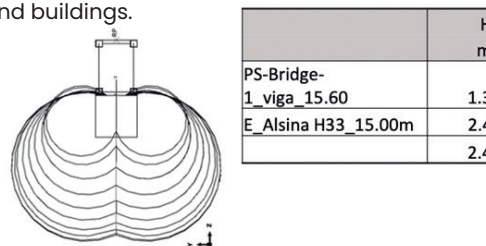
• **Applications of IOT, Digital Signage and Smart Communications to support operations and maintenance in municipalities and public spaces.**
Use of IOT technologies to improve the interaction of different physical elements in the municipalities with the citizens and maintenance staff.

The system is based into the application of smart intelligent signages connected to a smart information management system. Allowing users to access required information just approaching their mobiles phones to the signages.

• **Inflatable Breakwaters for sand beach protection.**
Existing solutions are based into Rigid Transversal breackwaters, that decrease the incipent wave height to reduce the These solutions are permanent unless they are not needed all the time, and it is an obstacle for natural refreshment of seawater, causing another important impact into the environment.

Main advantage of the new inflatable breakwaters is that they can be deployed only during storms and deflated otherwise. At the same time reducing the affection to the flora and fauna.
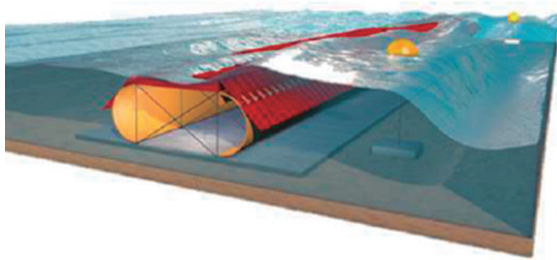
Highlighted technologies in the market licensed to spin-off companies

PS-Bridge (Market by PSTECH – Ultra-lightweight bridge for rapid deployment that solves current logistical needs in less than 5 hours)

Large Scale Inflatable Structures (Market by Buildair – Conceived as a membrane-strapanchorage system to ensure the stability and functionality requirements in front of the external and internal actions)

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Research Rankings

Webometrics Ranking

Recently, the **17ᵗʰ edition of Webometrics Ranking of Spanish researchers** and researchers working in Spanish Institutions (Spain) according to their Google Scholar Citations public profiles (*http://www.webometrics.info*) has been published.

This edition data was collected in December 2021. The list includes the top **100.000 profiles ranked by h-index** in decreasing order and then by the total number of citations.

Eugenio Oñate, professor of the School of Civil Engineering of UPC, is in the position 386ᵗʰ of the ranking with an h-index of h=78 and 27.684 citations.

There are **108 CIMNE researchers listed in Webometrics, three of them among the 1.000 first positions:**

- Prof. Eugenio Oñate (386ᵗʰ position)
- Prof. Antonio Gens (560ᵗʰ position)
- Prof. Eduardo Alonso (800ᵗʰ position)

This list ranks Prof. Eugenio Oñate, director of CIMNE, as the highest cited researcher of Universitat Politècnica de Catalunya · BarcelonaTech (UPC).

Webcindario Ranking

Another reference website in research ranking is Webcindario (*https://grupodih.info/*). In February 2022, it has updated its yearly list about prizes, women researchers and its ranking list by provinces.

The following list is a summary of the CIMNE researchers that appear in the one made by DIH Group / Webcindario:

Mathematics, Interdisciplinary Applications
Four CIMNE researchers are the top positions in this rank:
- Oñate, Eugenio (Fh: 1,39)
- Codina, Ramon (Fh: 1,05)
- Huerta, Antonio (Fh: 1)
- Idelsohn, Sergio (Fh: 0,95)

Engineering, Civil
- Barbat, Alex (Fh: 0,81)

Engineering, Geological
Three CIMNE researchers lead this rank:
- Gens, Antonio (Fh: 1,33);
- Alonso, Eduardo (Fh: 1,11);
- Lloret, Antonio (Fh: 0,69);

Engineering, Multidisciplinary
- Agelet, Carlos (Fh: 0,91)

RANKING OF CIMNE SCIENTISTS IN SPAIN

RANK	NAME	H-INDEX	CITATIONS	RANK	NAME	H-INDEX	CITATIONS
386	Eugenio Oñate	78	27684	3603	Enrique Romero	41	7794
560	Antonio Gens	71	22409	4929	Michele Chiumenti	37	4226
800	Eduardo Alonso	65	20966	5106	Sebastià Olivella	36	6513
1303	Ramón Codina	57	11254	5667	Alfredo Huespe	35	4314
1433	Antonio Huerta	55	12536	5729	Santiago Badia	35	3979
1661	Miguel Cervera	53	9436	8963	Carlos Agelet	29	2684
1806	Javier Oliver	51	14878	9494	Riccardo Rossi	28	2848
1825	Sergio Idelsohn	51	11418	9879	Melba Navarro	27	4892
2269	Alex Barbat	48	9390	10245	Luca Pelà	27	2592
2742	Sergio Oller	45	10321	10276	Pedro Díez	27	2556
3446	Marino Arroyo	42	6207	13472	Antonio Rodríguez	23	3284

Research Rankings

70

RANK	NAME	H-INDEX	CITATIONS	RANK	NAME	H-INDEX	CITATIONS
14280	José Sarrate	23	1587	51417	Stoyan Danov	7	222
15825	M. Liliana Carreño	21	2892	51459	Alex Ferrer	7	220
16545	Javier Príncipe	21	1533	52701	Jackson Tellez	7	169
19135	Gabriel Bugeda	19	1434	53115	Lucía Barbu	7	156
19493	Jaime Martí	19	1227	53597	Alex Jarauta	7	141
20263	Julio García Espinosa	18	1781	54054	Arnau Pont	7	125
20751	Juan Carlos Cante	18	1284	54240	Daniel García	7	117
21052	Joan Baiges	18	1127	54431	Javier San Mauro	7	106
21296	Josep María Carbonell	18	1009	54889	Abel Coll	6	377
22554	Narges Dialami	17	1088	55621	Gabriel Bernal	6	209
23037	Xavier Martínez	17	900	55770	Joaquín Irazábal	6	197
23153	Xue Zhang	17	862	55820	Mohammad Hashemi	6	193
24084	Mabel Marulanda	16	1136	55966	Eric Neiva	6	183
25327	Alberto Martín	16	681	56053	Pablo Becker	6	178
26102	Francisco Zárate	15	1009	56457	Jordi Cotela	6	160
26367	Cecilia Soriano	15	911	56793	Héctor Espinoza	6	147
27118	Pavel Ryzhakov	15	711	57186	Alessandra di Maríano	6	135
29412	Antonio Marí	14	624	57396	Kazem Kamran	6	130
30511	Oriol Lloberas	13	875	58019	Marcos Sanz	6	116
32251	Roubin Emmanuel	13	477	60591	Oriol Colomés	5	184
32851	Fernando Salazar	12	1007	60783	Jose Manuel González	5	164
32893	Miguel Ángel Celigueta	12	957	60929	Salvador Latorre	5	153
33087	Julio Marti	12	805	61016	Miquel Santasusana	5	148
33610	Antonia Larese	12	629	61031	Lorenzo Benedetti	5	147
34231	Mario Salgado	12	520	61713	César Velásquez	5	120
34977	Sergi Sauri	12	417	63162	Adrià Melendo	5	88
35112	Jordi Cipriano	12	396	65091	Alejandro Cornejo	5	60
35175	Ernesto Castillo	12	384	66183	David Vicente	4	191
35680	Marcelo Raschi	11	886	66224	Emilio Salsi	4	181
36025	Rafel Morán	11	659	66632	Jordi Carbonell	4	122
37153	Javier Mora	11	440	66997	David Roca	4	100
37346	Borja Serván	11	420	67110	Guillermo Casas	4	96
37472	Alessandro Franci	11	408	67211	Alba Hierro	4	92
37745	Francesc Verdugo	11	379	68368	Ilaria Iaconeta	4	66
38787	Jerrad Hampton	10	743	68452	Ignasi de Pouplana	4	65
39069	Daniel Di Capua	10	583	68520	Marina Arbat	4	64
39585	Xufei Lu	10	457	71066	Barbara Llacay	4	38
40698	Fermín Otero	10	339	71180	Christian Narvaez	4	37
41824	Hieu Nguyen	10	220	71744	Rubén Zorrilla	4	30
42154	Pedro Arnau	9	664	72815	Jesús Bonilla	3	85
42244	Pooyan Dadvand	9	603	72993	Nelson Lafontaine	3	74
44156	Enrique Ortega	9	279	73565	Claudio Zinggerling	3	56
44892	Jordi Pons Prats	9	232	73822	André Conde	3	51
45163	Roberto Flores	9	214	73947	Marc Olm	3	49
46077	Omar Salomon	8	429	74359	Davood Yazdani	3	43
46337	Ehsan Hajiesmaili	8	365	75506	Hadi Bakhshan	3	33
47700	Eduardo Soudah	8	240	75667	Javier Marcipar	3	32
49265	Prashanth Nadukandi	8	168	77073	Laura Moreno	3	24
50068	Enrique Escolano	7	463	82049	Alireza Taherzadeh	2	17
50142	Manuel Caicedo	7	423				
50281	Fernando Rastellini	7	367				

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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 2021.

NUMBER OF CIMNE PUBLICATIONS (1987–2021)	
Edited books	87
Text books	48
Research reports	417
Technical reports	643
Monographs	278
Papers in journals (since 2009)	1.126

Books 2021

Cervera Ruiz M., Blanco E., Mecánica Avanzada de Estructuras (digital), *CIMNE*, pp. 335, 2021.

Cervera Ruiz M., González J.M., Resistencia de materiales (digital), *CIMNE*, pp. 302, 2021.

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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Further info and DOIs available on cimne.com/papers2021

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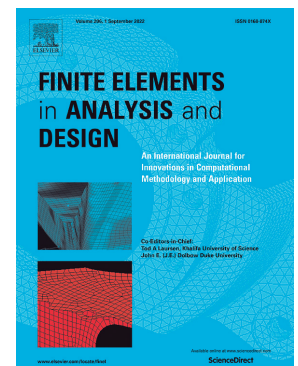
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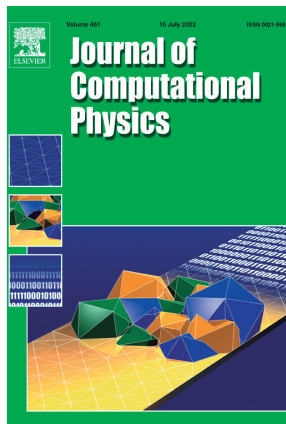
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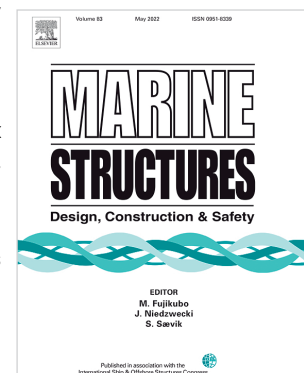
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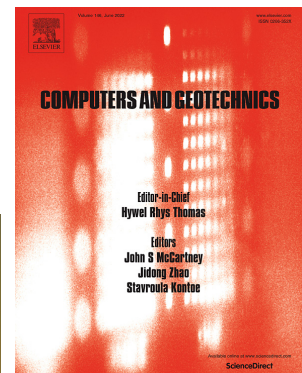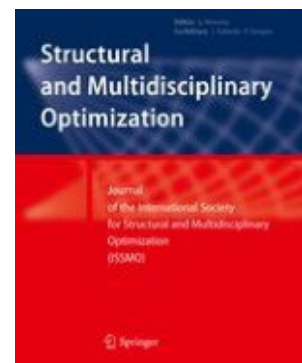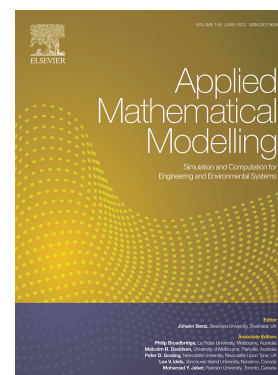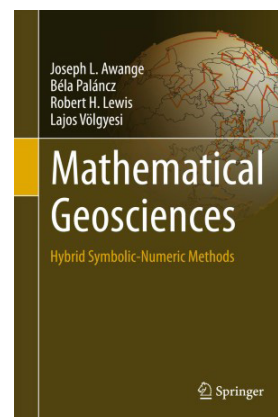
Innovation and technology transfer

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

P

Measurements
Laboratory experiments
On-Site monitoring, etc.

M

C

Computations
Numerical Methods
Software
Pre and Postprocessors
Interfaces, etc.

K

Knowledge
Data Bases
Knowledge management tools, etc.
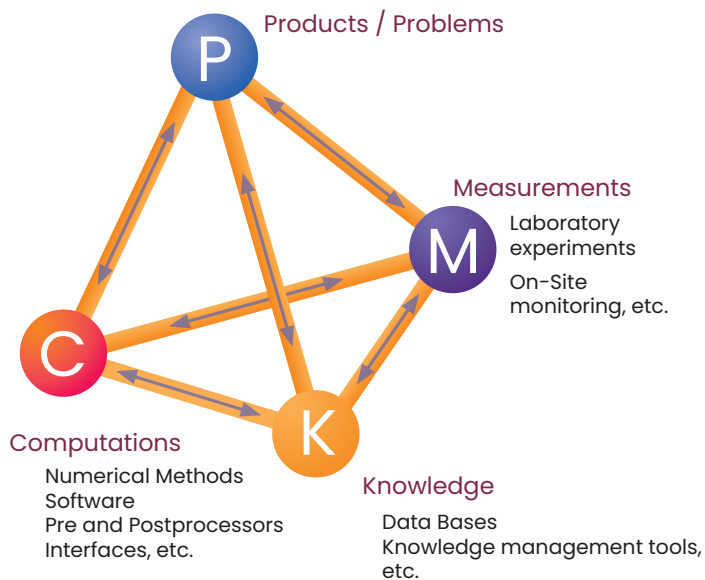
The mission and activity of CIMNE can be explained through the so-called Cycle of Ideas:

IDEA

Governmental Organizations

Market   University

PRODUCTS   RESULTS

Companies   CIMNE

A
B
C
D

PROTOTYPES
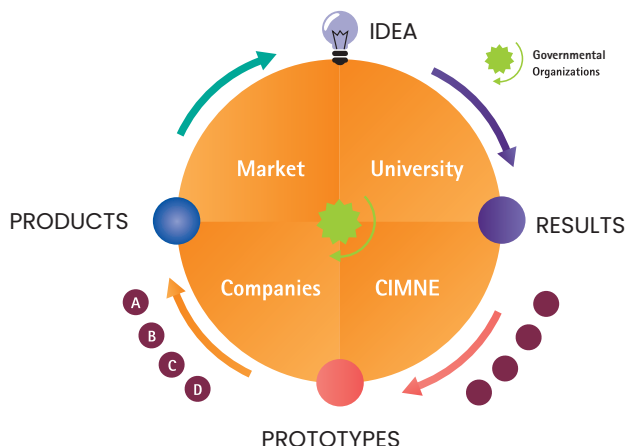
Ideas (scientific advances) usually originate in university environments, where many professionals study, investigate and discover new areas of knowledge. The idea matures until it produces tangible results (thesis, papers, computer programs, physical devices, etc.) that have to be filed and protected. **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
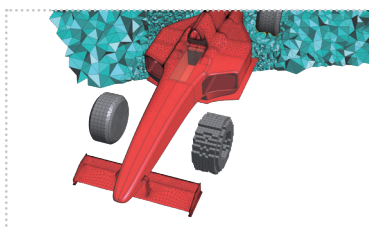
A universal and adaptive pre and postprocessor for computer simulation in engineering and applied science.
Developed & marketed by CIMNE since 1998. ✪ **www.gidhome.com**

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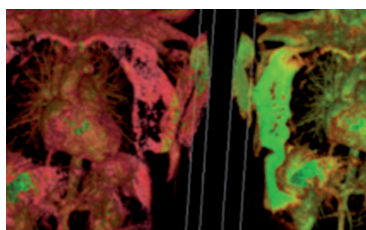
Versatile platform for digital image processing combined with numerical modelling and simulations.
Developed and marketed by CIMNE since 2011.

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**

WATER-PS

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

COLLABORATIVE WORK PLATFORMS

MI COLEGIO EN RED

Communications system and integrated services designed specifically for schools via the Internet. Developed and marketed by CIMNE since 2000. ✴ **cimne.com/mcr**

FRAKTALIS

Customizable web application that creates virtual communities where users can communicate and share. Developed and marketed by CIMNE since 2009. ✴ **fraktalis.com**

EDUCATIONAL SOFTWARE

Educational software for interactive learning about structural design and finite element method. Developed and marketed by CIMNE. ✴ **cimne.com/educational**

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**
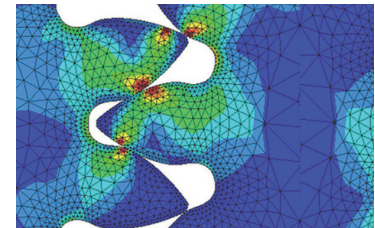
MAT-FEM

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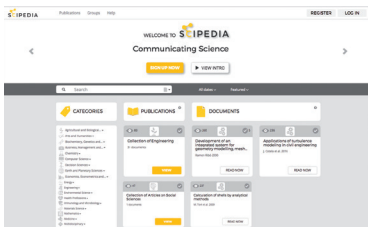
Web platform for free publishing and open access of scientific publications. Developed by Scipedia, S.L. in cooperation with CIMNE. Marketed by Scipedia, S.L. since 2016. ✴ **scipedia.com**

DECISION SUPPORT SYSTEMS

BEACHING

Information system for management of tourism activities in beach areas. Developed by CIMNE and marketed by TAOC SA since 2011. ✴ **beaching.com**

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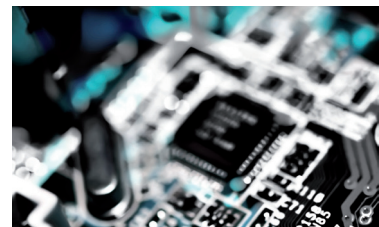
Integrated platform for robust multiobjective optimization in engineering. Developed by CIMNE. ✴ **tts.cimne.com/RMOP**

DECISION SUPPORT SYSTEMS

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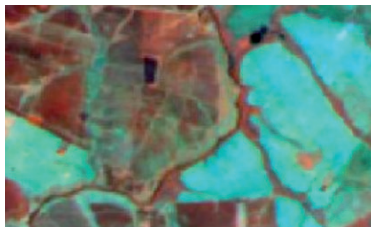
Web-based interactive Geographic Information System. Developed by CIMNE.

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**

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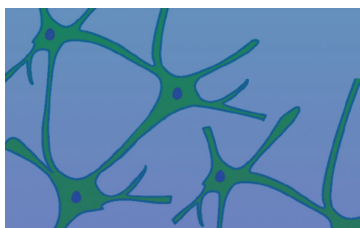
Artificial neuronal network package. Developed by CIMNE. ✪ **cimne.com/flood**

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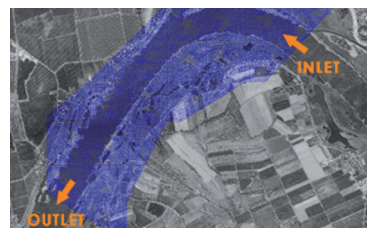
Decision support system for risk assessment and managing of floods. Developed by CIMNE and Flumen. ✪ **www2.cimne.com/ramflood**

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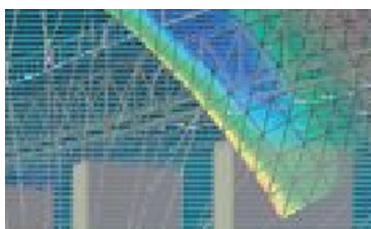
An integrated platform for e-monitoring using wireless sensor network technology. Developed by CIMNE. ✪ **www2.cimne.com/wsnp**
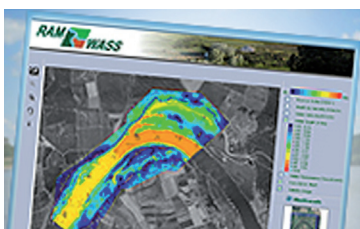
RAMWASS

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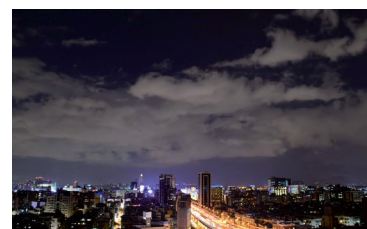
Open source BiG Data Analytics platform for deep analysis of massive data coming from smart metering infrastructure of utility companies. Developed by CIMNE and marketed by Inergy. ✪ **beedataanalytics.com**

SIMULATION SOFTWARE FOR INDUSTRIAL PROCESSES

WELDPACK

Welding processes software. Developed by CIMNE.

STAMPACK
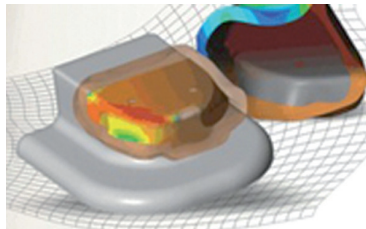
Software for sheet metal forming processes. Developed by Quantech ATZ, SA and CIMNE. Marketed by Quantech ATZ, SA since 1999.

⭐ **stampack.com**

CLICK2CAST
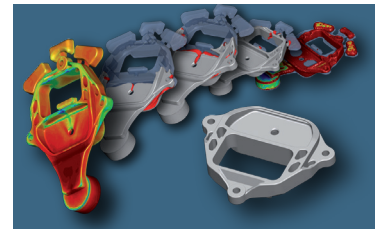
Software for fast simulation of casting processes. Developed by Quantech ATZ in cooperation with CIMNE. Marketed by Altair since 2015.

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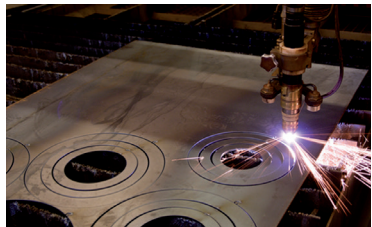
Software able to simulate cutting processes for the metal manufacturing industry. Developed by CIMNE.

ADD2MAN
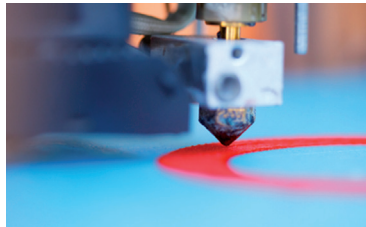
Additive manufacturing processes software. Developed by CIMNE in cooperation with Eurecat.

FORGEPACK

Forging manufacturing processes software. Developed by CIMNE.

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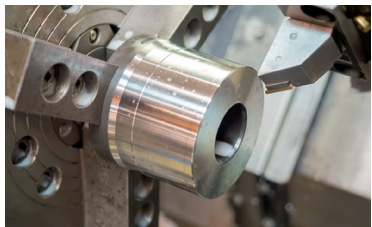
Software able to simulate machining manufacturing processes. Developed by CIMNE.

SPREADDEM
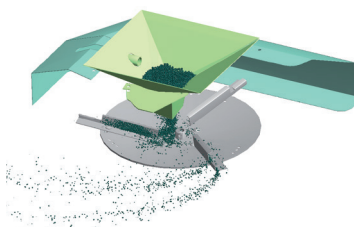
Simulation software for the study of the particle flow on centrifugal fertilizer spreaders. Developed and marketed by CIMNE.

⭐ **cimne.com/spreaddem**

SIMULATION SOFTWARE FOR MULTIPHYSICS

KRATOS
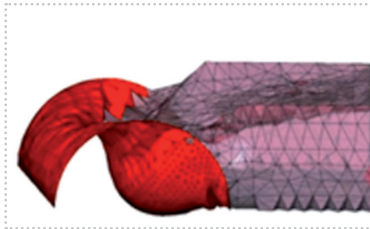
Object-oriented software platform for the development and application of finite element codes for multidisciplinary applications. Developed by CIMNE.

✪ **cimne.com/kratos**

ERMES
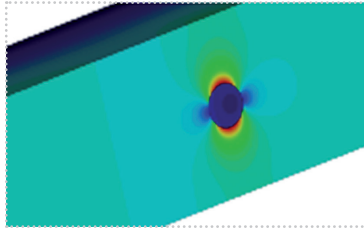
Computational electromagnetics using advanced finite element methods.
Developed by CIMNE.

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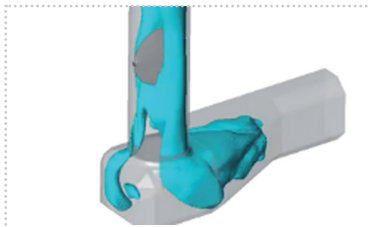
Finite element code for analysis of a wide range of multi-physic problems in engineering and applied science. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE. Marketed by Compass since 2003. ✪ **compassis.com**

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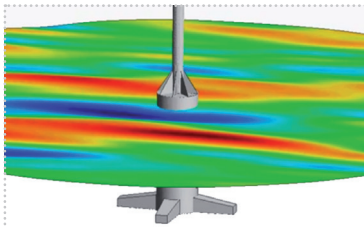
Hydrodynamics and seakeeping analysis of ships and marine structures. App for wind tower generators in the sea. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE. Marketed by Compass since 2011.

✪ **compassis.com**

PFLOW
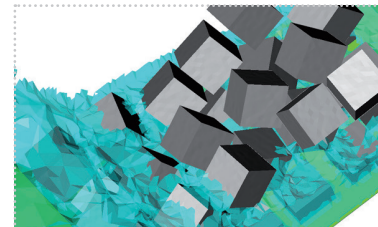
Analysis of fluid dynamics and fluid-structure-soil-thermal interaction problems into the Particle Finite Element Method (PFEM).
Developed by CIMNE.

✪ **cimne.com/pfem**

PARACHUTES

Computer program for the fast simulation of parachute-payload systems. Developed and marketed by CIMNE since 2016.

✪ **cimne.com/parachutes**

↗ cimne.com/products

SIMULATION SOFTWARE FOR STRUCTURAL ENGINEERING

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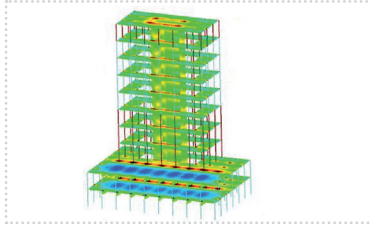
Finite element code for analysis of structures in engineering and architecture. Developed by Compass Ingeniería y Sistemas, SA. and CIMNE.
Marketed by Compass since 2003.

✖ **www.compassis.com**

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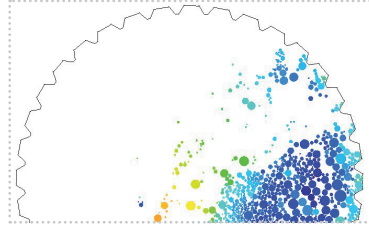
Analysis of granular systems and multifracturing problems in geomechanics and industrial processes using discrete and finite element methods. Developed by CIMNE.

✖ **cimne.com/dem**

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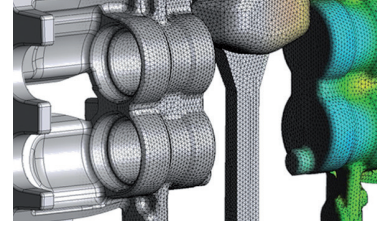
Finite element code for none linear analisys of thermomechanical problems in solid and structural mechanics acounting for frictional contact situations. Developed by CIMNE.

✖ **cimne.com/comet**

BIOMECHANICS & HEALTH

HEALTH APP

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

✖ **bcnhealthapp.com**

E
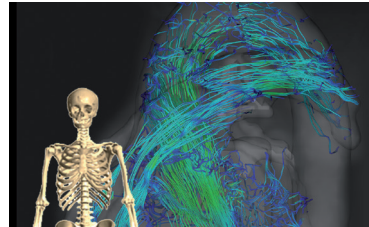
Multiscale representation and analysis of the human body. Developed by CIMNE.

✖ **cimne.com/bodygid**

VISIT CIMNE PRODUCTS AT
CIMNE.COM/PRODUCTS

Spin-off companies

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 WITH PARTICIPATION OF CIMNE TECNOLOGIA SAU:

BUILDAIR INGENIERÍA Y ARQUITECTURA, SA
Created in 2001

✪ **buildair.com**

Inflatables structures for engineering and architecture applications.
CIMNE Tecnología SA owns 3,60% of Buildair.

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 Analytics, SL.

COMPUTATIONAL AND INFORMATION TECHNOLOGIES, SA
Created in 2012

✪ **citechsa.com**

Computational methods and information technology systems in engineering. 100% owned by CIMNE Tecnología SA.

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.

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.

LYNCOS TECHNOLOGIES, SL
Created in 2012

✦ **lhings.com**

Software and systems for the Internet of Things.
CIMNE Tecnología SA owns 4,77% of Lyncos Technologies, SL.

PORTABLE MULTIMEDIA SOLUTIONS, SL
Created in 2013

✦ **portablemultimediasolutions.com**

Mobile pavilions with multimedia technology for leisure, sport and events. 22,6% owned by CIMNE Tecnología SA.

PNEUMATIC STRUCTURES TECHNOLOGIES, SL
Created in 2015

✦ **ps-technologies.com**

Pneumatic structures for a wide range of engineering problems. 9,5% owned by CIMNE Tecnología SA.

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, 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

⎘ cimne.com/spin-offs

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).

Secretariat of SEMNI Since 1989

Pilot Center of ERCOFTAC in Spain Since 1989

Secretariat of ECCOMAS Since 1992

Secretariat of IACM 1994 – 2016

Partner of FLUMEN Since 2012

Creation of AIAC Since 2015

Unesco Chair in Numerical Methods in Engineering

UNESCO and UPC · BarcelonaTech reached an agreement to create the first UNESCO chair in the world in 1989: the UNESCO Chair of Numerical Methods in Engineering.

Dr. Jacques Périaux

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. The network is the seed for creating other expected nodes in countries of Africa and Asia.

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

Organización
de las Naciones Unidas
para la Educación,
la Ciencia y la Cultura

Cátedra UNESCO
de Métodos Numéricos en Ingeniería
Universidad Politécnica de Cataluña.
BarcelonaTech

FLUMEN Institute

In 2012, the Government of Catalunya created the FLUMEN Institute for River Dynamics and Hydrologic Engineering as a partnership between CIMNE and UPC · BarcelonaTech.

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

SEMNI
Sociedad Española de Métodos Numéricos en Ingeniería

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

The basic aims of SEMNI are the organization and coordination of all 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, the United States Association for Computational Mechanics in the United States, and the Asociación Argentina de Mécanica Computacional, 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 will organize the congress CMN 2022 (Congress on Numerical Methods in Engineering) on September 12-14, 2022, in the city of Las Palmas de Gran Canaria (Spain).

European Community on Computational Methods in Applied Sciences

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 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.

The WWCM Congress in Computational Mechanics & ECCOMAS Congress, that took place from January 11th to 15th, 2021, had to be celebrated virtually for the first time in its history, due to the COVID-19 crisis. However, the edition has gathered more than 3000 participants from 30 countries and its organizers make a positive balance: "Nearly 150 sessions were held! Together with the 2500 questions and comments posted on the different talks, they have been the source of rich and inspiring scientific debates". More than 280 symposia have been celebrated during this edition which counted with more than 2500 contributors.

From 5th to 9th June, 2022, the Eccomas Congress 2022 will take place in Oslo (Norway). Further details could be found on the website **eccomas2022.org**.

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

International Association for Computational Mechanics

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

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 research 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 15th World Congress on Computational Mechanics – APCOM 2022 will take place in online mode from 31st July to 5th August, 2022, in Yokohama (Japan).

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

www.iacm.info
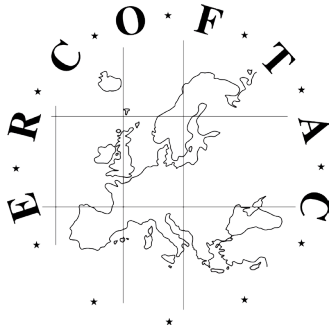
European Research Community on Flow, Turbulence and Combustion

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.

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.

AIAC
Asociación Internacional de Aulas CIMNE

International Association of Aulas CIMNE

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.

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 seminars, 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 2021. The agenda of congresses and conferences that will take place during 2022-2023, it is also included.

Training

POST-GRADUATE STUDIES

COURSES

SEMINARS

COFFEE TALKS

CONFERENCES

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
🔗 *cimne.com/mumni*

Master of Science on Computational Mechanics
Duration: 2 academic years, 120 ECTS
🔗 *cimne.com/mcm*

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 2021:
- Initiation (English)
- Advanced courses (only in Spanish):
  - Dam breaks
  - Water quality
  - Hydraulic works
  - Sediment transport

Anura3D Online Workshop 2021
30/04/2021, Online
Recent developments and applications of the Material Point Method for soil-water-structure interaction.

EXCELENCIA
SEVERO
OCHOA

Severo Ochoa (SO) Seminars at CIMNE in 2021

12 SO seminars

448 attendees

▶ Available online

From low-to high-order discretisations in surrogate models for parametric CFD problems
Matteo Giacomini
CIMNE/UPC (Spain) – 24/02/2021

The P-DNS method, a multiscale approach to solve fluid dynamics problems
Juan Marcelo Giménez
CIMNE/UPC (Spain) – 24/03/2021

Get to know Horizon Europe (HE), the new EC Framework Programme, and the new CIMNE's Preaward Unit
Cecilia Soriano, Alicia Pallarés, Marina de la Cruz, Sandra Pérez, Lucía Barbu and Fernando Salazar
CIMNE (Spain) – 21/04/2021

Shape prior metal artifact reduction algorithm for industrial 3D cone-beam CT
Chang-Ock Lee
KAIST (South Korea) – 19/05/2021

Acoustic black holes in mechanics
Oriol Guasch
URL (Spain) – 17/06/2021

The shifted boundary method for embedded solid mechanics
Guglielmo Scovazzi
Duke University (USA) – 29/06/2021

High-fidelity simulation of pathogen propagation, transmission and mitigation in the built environment
Rainald Lohner
George Mason University (USA) – 08/07/2021

Structured Low-Rank Approximation: Theory, Algorithms, and Applications
Ivan Markovsky
Vrije Universiteit Brussel (Brussels) – 09/07/2021

Machine learning: an engineering perspective and some applications in combination with numerical modelling
Fernando Salazar
CIMNE – 14/07/2021

The Finite Volume Method for sediment transport in rivers. Practical Applications
Ernest Bladé
CIMNE/UPC – 20/10/2021

Two-scale H(div)-conforming approximations for hybrid-mixed finite element model
Sonia Maria Gomes
Institute of Pure and Applied Mathematics (Brazil) – 18/11/2021

A fully explicit Lagrangian Finite Element Method for highly nonlinear Fluid-Structure Interaction problems
Massimiliano Cremonesi
Politecnico di Milano (Italy) – 15/12/2021

**EXCELENCIA
SEVERO
OCHOA**

Severo Ochoa (SO) Coffee Talks at CIMNE in 2021

12
Coffee talks

426
attendees

▶
**Available
online**

Virtual and augmented reality for Safety in construction
Felipe Muñoz
CIMNE/UPC (Spain) – 03/03/2021

Tdiary, human resources and knowledge management in companies. Why is it important to keep a log of employees' activities?
Ramon Ribó
CIMNE /COMPASSIS (Spain) – 28/04/2021

Biomimetics. A new paradigm of the Circular Economy. Sustainability through renaturation
Pere Monràs
Biomimetic Sciences Institute (Spain) – 12/05/2021

Cómo no preparar una propuesta
Javier Mora
CIMNE (Spain) – 01/06/2021

34 years of CIMNE and beyond. A personal view
Eugenio Oñate
CIMNE (Spain) – 09/06/2021

πPLATES. Pilot Platform to support Predictive Land Management and Sustainability
Pere-Andreu Ubach
CIMNE/UPC (Spain) – 23/06/2021

Generalized finite difference and infiltration patterns in porous media
Daniel Santana
Jefferson International University (Mexico) – 07/07/2021

Was the Mediterranean once a desert? The Messinian Salinity Crisis: 50 years of controversy and recent advances from a modelling perspective?
Hanneke Heida
Utrecht University (Mexico) – 01/09/2021

Virtual Laboratory of Structures
Francisco Zárate and Diego E. Aguilera
CIMNE (Spain) – 29/09/2021

Research lines of AULA CIMNE - UPM ETSII
David J. Vicente and Jorge Rodríguez
CIMNE Madrid/UPM (Spain) – 27/10/2021

Open access publication: practical criteria and available tools
CIMNE Preaward Unit
CIMNE (Spain) – 10/11/2021

Public-Private Collaboration Projects (formerly Collaboration Challenges). A great opportunity to finance applied research
Fernando Salazar
CIMNE(Spain) – 24/11/2021

Conferences organized by CIMNE in 2021

WWCM 2021
World Congress on Computational Mechanics & ECCOMAS 2020

11 - 15 January 2021, Virtual Conference

MARINE 2021
IX International Conference on Computational Methods in Marine Engineering

2-4 June, 2021, Edinburgh, Scotland, UK

CSAI 2021
Computational Science and AI in Industry

7 - 9 June 2021, Trondheim, Norway

COUPLED 2021
IX International Conference on Coupled Problems in Science and Engineering

13-16 June, 2021, Chia Laguna, South Sardinia, Italy

ADMOS 2021
International Conference on Adaptive Modeling and Simulation

21-23 June 2021, Gothenburg, Sweden
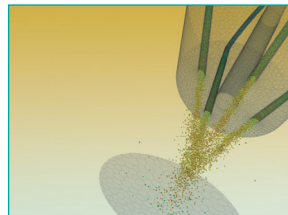
Sim-AM 2021
International Conference on Adaptive Modeling and Simulation

1 - 3 September, 2021, Online Format

COMPLAS 2021
XVI International Conference on Computational Plasticity

7-10 September 2021, Barcelona, Spain

STRUCTURAL MEMBRANES 2021
X International Conference on Textile Composites and Inflatable Structures

13-15 September 2021, Munich, Germany

M2P
Math 2 Product

15 - 17 September, 2021, Vietri sul Mare, Salerno, Italy

XII Jornadas Españolas de Presas - SPANCOLD 2021
Last week September 2021, Gran Canaria

COMPOSITES 2021
12th International Conference on Structural Analysis of Historical Constructions

29 September - 1 October 2021, Barcelona, Spain

SAHC 2021
12th International Conference on Structural Analysis of Historical Constructions

29 September - 1 October 2021, Barcelona, Spain

PARTICLES 2021
VII International Conference on Particle-Based Methods

4-6 October, 2021, Hamburg, Germany
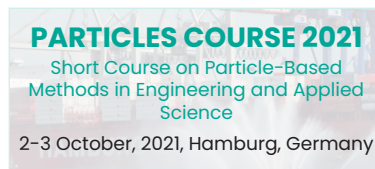
PARTICLES COURSE 2021
Short Course on Particle-Based Methods in Engineering and Applied Science

2-3 October, 2021, Hamburg, Germany

cimne.com/conferences

Upcoming conferences organized by CIMNE in 2022 and 2023

GiD Convention 2022
Convention on Advances and Applications of GID
1 June, 2022
Online

ECCOMAS CONGRESS 2022
8th European Congress on Computational Methods in Applied Sciences and Engineering
5 - 9 June 2022
Oslo, Norway

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

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

SLOPES SYMPOSIUM
X National Symposium on Unstable Slopes
13 - 16 September, 2022
Granada, Spain

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

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

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

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

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

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

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

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.gidhome.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

The International Centre for Numerical Methods in Engineering 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 2019-2023.

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.

Awards and honours to CIMNE Scientists in 2021

Below we list the most highlighted recognition and awards granted to CIMNE scientists during the year 2021.

CARMEN ANDRADE
Fib Fellow
International Federation for Structural Concerte - Fédération Internationale Du Béton (Switzerland)

FABIOLA CAVALIERE
Mike Crisfield Prize
UK Association for Computational Mechanics (UKACM)

DAVID CODONY
Best PhD Thesis of the Year
Spanish Society for Numerical Methods in Engineering (SEMNI)

MATTEO GIACOMINI
Juan Carlos Simó Prize
Spanish Society for Numerical Methods in Engineering (SEMNI)

cimne.com/awards

CIMNE in the media 2021

MACHINE LEARNING

Study for the detection of ALS through the voice

The research is based on the analysis of the voice with artificial intelligence models that could allow the early detection of bulbar involvement in ALS. This is a collaboration between CIMNE and the University of Lleida in which the Bellvitge Hospital participated and has consisted in the development of automated voice markers to identify the first effects of the disease.
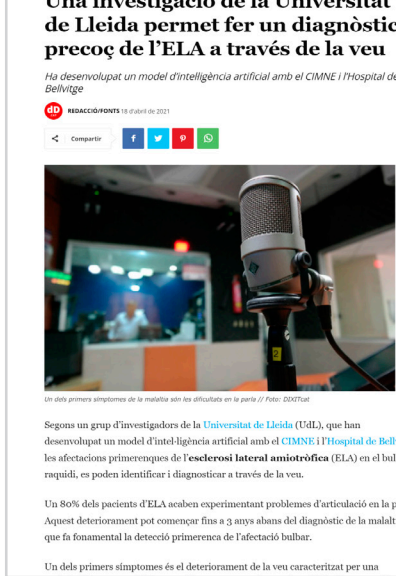
El caso de Barcelona

La redefinición del espacio urbano como instrumento de transformación de las ciudades y gestión de la movilidad

En la ciudad de Barcelona, de un modo similar a otras urbes, están acaeciendo una serie de iniciativas encaminadas a redefinir el modelo y los usos del espacio urbano. En este artículo nos centraremos en la más relevante de estas actuaciones, las superislas. No sólo hay que observarla en términos de espacios, de actuaciones zonales, sino que tiene una trascendencia no despreciable sobre la dinámica del conjunto de la ciudad y sobre la planificación urbana. A continuación, se presentarán los rasgos fundamentales de las superislas y se analizarán bajo dos marcos de referencia: uno temporal, el de las tendencias del urbanismo en las últimas décadas; y otro el de la interacción de esta medida con el conjunto de la ciudad.

Palabras clave Superisla, ciudad, movilidad, tráfico, coche.

In the city of Barcelona, similar to other cities, a series of initiatives are being carried out to redefine the model and uses of urban space. The macroblocks represent the most singular initiative. Not only should we consider this measure as a spatial reorganization, but it has a transcendental impact on the dynamics of the entire city and on urban and mobility planning. This article will present the fundamental aspects of macroblocks and analyze the main challenges involved in their implementation.

Keywords Superblock, city, mobility, traffic, car.

Eurecat participa en un proyecto para reducir el peso del chasis de vehículos eléctricos

El centro tecnológico **Eurecat** participa en el proyecto Fatigue4Light (Fatigue modelling and fast testing methodologies to optimise part design and to boost lightweight materials deployment in chassis parts), que cuenta con un presupuesto de 5.530.292 euros y que se centra en el desarrollo de nuevos ensayos y nuevas metodologías de simulación por ordenador para estimar con mayor precisión la vida a fatiga de los componentes del chasis y seleccionar los materiales óptimos para chasis de vehículos más ligeros.

El proyecto Fatigue4Light, iniciado en febrero de 2021, trabajará durante tres años en la aplicación de nuevos materiales adaptados a los requisitos del chasis de los vehículos, como aceros avanzados de alta resistencia, aleaciones de aluminio de alta resistencia y materiales híbridos metal-composites reforzados con fibras.

El objetivo es "reducir el peso del chasis del vehículo en comparación con las soluciones actuales utilizando materiales avanzados y teniendo en cuenta los aspectos de ecodiseño y economía circular", detalla el director científico de Eurecat, Daniel Casellas.

Los resultados del proyecto optimizarán la selección de nuevos materiales y reducirán notablemente el tiempo de implementación entre el desarrollo del material y el diseño de una nueva pieza del chasis.

El proyecto Life4MedECA

por Félix Martín De Loeches | 7 abril, 2021

No ha despertado mucho interés en los medios informativos marítimos españoles un proyecto aprobado por la UE que pretende el desarrollo de una área ECA (*E...* Mediterráneo.

Como ya hemos publicado hace algún tiempo, existen unas áreas denominadas ECA en diferentes partes de la geografía mundial que exigen que el combustible de los buques que naveguen por aguas territoriales de los países firmantes de los acuerdo ECA, utilicen combustibles un porcentaje igual o menor 0,1% de SOx (hoy la IMO exige menos de 0,5%).

Estas áreas están hoy situadas en las costas Este y Oeste, en Estados Unidos y Canadá; mar Báltico y mar del Norte en Europa; Corea, Japón, y determinadas áreas de China, entre otras. Pero el mundo Mediterráneo no ha sido capaz de acordar la concreción de un área ECA que, al final, significa menos contaminación. Este mar, con un entorno superpoblado y unos niveles de contaminación elevados, debería de ser un área ECA sin mayor problema; sin embargo una cosa es el Norte y otra el Sur de este "mare Nostrum".

La ACA impulsa la creación de un observatorio sobre inundaciones

Agencia Catalana del Agua

- Se están destinando 500.000 euros en el análisis de episodios como los producidos a raíz de la Dana de octubre de 2019 y el temporal Gloria del mes de enero de 2020, como las causas de la crecida del río Francolí y el análisis de la inundabilidad en el tramo final del río Tordera.
- Se han impulsado también estudios dirigidos a la mejora del conocimiento de la capacidad de respuesta hacia la...

@2021 IN TWEETS / TOP TWEETS

CIMNE carries out an intensive activity through social media, with special attention to Twitter, where the centre has some 2.000 followers. Below we highlight some of the 2021 tweets to explain CIMNE's activities through the networks.

JANUARY'21

Marino Arroyo, @IrenelArias, Xavier Oliver and @DirectorCIMNE awarded at WWCM in Computational Mechanics & ECCOMAS Congress

FEBRUARY'21

Today #11F2021 we present you the research projects led by Lucía, Anna, África and Eglantina in mechanical engineering, geomechanics, safety in ro-ro ships and sustainable transport #WomenInScience

MARCH'20
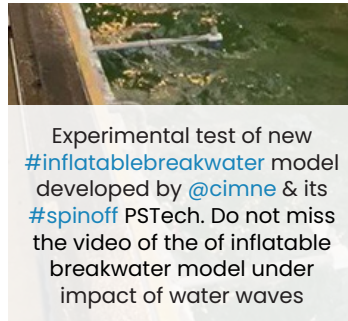
Experimental test of new #inflatablebreakwater model developed by @cimne & its #spinoff PSTech. Do not miss the video of the of inflatable breakwater model under impact of water waves

APRIL'21

.@DirectorCIMNE ranked 30th position in the worldwide ranking of #AppliedMathematics scientists @iCERCA

MAY'21

@cimne scientists involved in the @ExaQUteEU project celebrating the @iCERCA anniversary #JoSocReCERCAire

JUNE'21

Investigadores del @cimne @cimatoficial, conferenciantes de la sesión especial de métodos numéricos del V Encuentro Conjunto de la Soc. Matemática Mexicana y la @RealSocMatEsp, que tendrá lugar del 14 al 18 de junio. ¡Evento virtual!

JULY'21

La investigadora @cimne @barbu_lucia impartirà una xerrada sobre mecànica computacional com a eina transversal a l'indústria al Cicle de Ponències dels #PremisExtraordinaris de #Batxillerat

AUGUST'21

Some #joboffers near to expire. Check the open positions at @cimne here:
> Research staff
> Administration staff

SEPTEMBER'21

#COMPLAS organizers (Djordje Peric and Eduardo de Souza Neto from @SUEngineering and Michele Chiumenti @la_UPC with @DirectorCIMNE during the #complascourse2021

OCTOBER'21
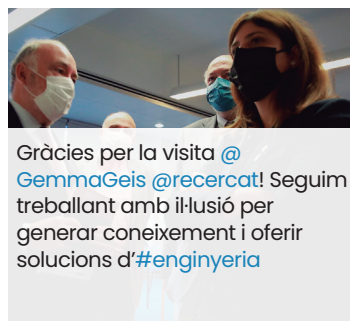
Gràcies per la visita @GemmaGeis @recercat! Seguim treballant amb il·lusió per generar coneixement i oferir solucions d'#enginyeria

NOVEMBER'21

.@cimne está en #100xCiencia5, un acto que reúne a comunicadores y científicos en el que están teniendo gran protagonismo la divulgación científica y las vacunas #COVID19 @SOMM_alliance

DECEMBER'21

Today we are doing a welcome action with new PhD at @cimne

CIMNE MULTIMEDIA CHANNEL

Do not miss out our playlists! Check out CIMNE's outreach activities. Conferences, projects, workshops and much more!

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