

Position Description

Group of research topics: Additive manufacturing

Position is funded by	<ul style="list-style-type: none"> - COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon 2020, European Union - Centre Internacional de Mètodes Numèrics a l'Enginyeria (CIMNE), Spain - RMIT University (RMIT), Australia
Research Host	CIMNE and UPC, Spain
PhD awarding institution/s	Dual PhD awarded by the Polytechnic University of Catalonia (UPC) and RMIT University, Australia
Locations	<ul style="list-style-type: none"> - Primary: Barcelona, Spain - Secondary: Melbourne, Australia - Annual workshops in Barcelona, Spain
Contract	Full time, 36 months
Gross annual salary	25.898 EUR (gross amount before employee's taxes and contributions)
Preferred start date	01/01/2023 (tentative)
Deadline for applications	19/09/2022 (Reference: CIMNE-DC1)

Your choice of research topics (only one of these projects will be funded):

Project 1: Thermo-metallurgical modelling for AM processes	Project 2: Thermo-mechanical modelling of WAAM process	Project 3: Modelling of multi-material L-PBF process
<p>The project will focus on the thermo-metallurgical coupling for additive manufacturing (AM) process simulation at melt-pool and at component scale level. Direct-Energy-Deposition (DED) will be used as the main AM technology. The key objective is to develop a numerical model to predict the microstructure evolution including phases, grain size and mechanical properties induced by the thermal cycles due to the AM process. Moreover, its relationship with the material strength will be investigated.</p>	<p>Wire arc additive manufacturing (WAAM) is a directed energy deposition (DED) AM process that uses an electric arc as a heat source to melt a wire feedstock. The WAAM process is capable of producing thin-walled components and is relevant for many industries, such as aerospace, automotive and marine. This PhD project will focus on the thermo-mechanical modelling linking the processing parameters and resultant mechanical properties and defect formation.</p>	<p>Multi-material additive manufacturing using laser-based powder bed fusion (L-PBF) has the potential to disrupt the manufacturing of multi-material parts and enable local tailoring of mechanical and functional properties. In this PhD project, the candidate will develop thermomechanical models to investigate the formation of interfaces and study the complex melt flow in metal-metal composites.</p>
<p>Supervisors: Prof. Michele Chiumenti (CIMNE) and A/Prof. Andrey Molotnikov (RMIT), Prof Raj Das (RMIT)</p>		

Research Fields: Computational mechanics, Advanced manufacturing and mechatronics, Applied science, Mechanical and Automotive engineering, Distributed Computing.

For more information on the Projects, contact us: redi.help@rmit.edu.au

Are you REDI? (Expected Profile)

Your background and skills: You should possess advanced knowledge of Continuum and Computational Mechanics (master level) and Material science (metallurgy). Likewise, programming skills, like Fortran 2008 Object-Oriented, are considered an asset. Lastly, high working knowledge of English (Minimum B2) is required.

Your work experience: Professional experience is not required.

Your research experience: Research experience in Computational Mechanics, FE method including writing of user subroutines, programming skills (object oriented) and metallurgy is required.

For more information about the general conditions of the REDI Program and the Eligibility Criteria, please visit: <https://www.rediprogram.eu/>

Employment Benefits and Conditions

CIMNE offers a 36-months position based in Barcelona (Spain), extendable up to 48 months in duly justified cases. International travel is foreseen, including to Australia (up to 12 months). There is a probation period of three (3) months and there are 40 working hours per week.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a gross annual salary of est. 25.898 EUR gross per year (gross amount before employee's taxes and contributions). Of this amount, the estimated net salary to be perceived by the Researcher is est. 1.704 EUR net per month*. However, the definite amount to be received by the Researcher is subject to national tax legislation. For more information on the estimated net salary, please use the [net salary calculator](#).

**Net salaries can fluctuate in accordance with an individual's personal circumstances (marital status, age, disability, family and dependents, etc. The above indicative net salaries offer an approximation of what a single person in their early 20s could expect to receive in their bank account after taxes.*

Benefits include:

- 23 days paid holiday leave
- Sick leave
- Parental leave
- The candidate will have access to HPC CIMNE computational cluster (<https://hpc.cimne.upc.edu>) and also have access to the experimental facilities at RMIT Centre for Additive Manufacturing (www.rmit.edu.au/research/cam)
- 1,000€ yearly travel allowance to cover flights and accommodation to participate in the annual workshop at RMIT Europe in Barcelona (Spain)
- 10,000€ allowance to cover flights and living expenses for up to 12 months in Australia

For more details, please see: https://doctorat.upc.edu/en/programmes/structural-analysis?set_language=en

REDI to apply? First a little more about us...

CIMNE

The International Centre for Numerical Methods in Engineering - CIMNE, (www.cimne.com) is a research centre, created in 1987 by consortium between the Catalan Government and the Technical University of Catalunya (UPC), devoted to the development and application of numerical methods to a wide range of areas in engineering. CIMNE has been selected as a Severo Ochoa Centre of Excellence for the period 2019-2023. This is the highest level of recognition of excellence and leadership awarded to a research centre in Spain.

CIMNE is focused on the numerical simulation in both solid mechanics and fluid dynamic analysis related to a wide class of engineering problems and particularly metal forming processes including Additive Manufacturing.

The research activity carried out at CIMNE includes:

Mathematical formulation and solution strategies;

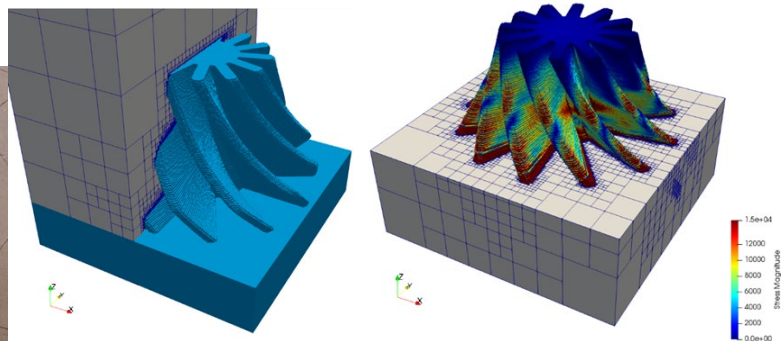
Numerical methods and software implementation issues;

Multi-physic approaches and multi-scale techniques and including metallurgical models;

Large scale simulation via HPC computing focused on industrial applications.



Hand-prosthesis made by Additive Manufacturing (FFF)



Turbine component made by Ti64 AM process (DED)

CIMNE is devoted to the development of ad-hoc specialized software platform for the numerical simulation of different industrial processes such as casting, welding, Additive Manufacturing processes as well as Heat Treatment analysis. The numerical simulation of the entire process manufacturing chain including standardization of the material database and I/O formats is also a leading R+D line at CIMNE. Developments of numerical simulation of Additive Manufacturing (AM) processes by Metal Deposition (MD) by a fully coupled thermo-mechanical framework tailored to the analysis of both wire-feeding and blown-powder and powder bed technologies. Complex thermo-viscoelastic-viscoplastic material models are available to characterized different alloys for the fabrication of various components for the aeronautical and aerospace industry. An advanced high-performance and object-oriented software platform has been developed reaching highly scalable implementation based on Balancing Domain Decomposition by Constraints (BDDC). Great performance of this HPC framework is ensured for the solution of complex industrial application including AM simulations. The material models are calibrated and the numerical results are validated through the experimental campaign carried out at different laboratories.

CIMNE is actively working on the internationalization of the research, creating links and collaborations with research/industrial centers worldwide, e.g. in Australia (Monash University, **RMIT** university), China (Northwestern Polytechnical University of Xi'an, and the SKLSP Laboratory), Peru (Pontificia Universidad Católica del Perú - PUCP) and multiple centers in Europe (Hydro and SAPA in Sweden, Fraunhofer and ACCESS in Germany, CNR in Italy, SINTEF and NEST-AS in Norway, LTAS-MN2L in Belgium, IK4-LORTEK, Spain).

Engineering Mechanics - Industrial Manufacturing Processes group

The PhD candidate will be integrated into the Industrial Manufacturing Processes group. The main activity of the group is:

- Manufacturing processes simulation including Additive Manufacturing and FSW processes
- Advanced mixed finite element technology
- Constitutive modeling including Failure Mechanics
- Multi-scale and multi-physics analysis

The research team is formed at present by:

Prof. Michele Chiumenti: <http://chiumenti.rmee.upc.edu/index.html>

Prof. Miguel Cervera: <http://cervera.rmee.upc.edu/>

Dr. Narges Dialami

Dr. Manuel Caicedo

As well as 7 PhD students.

The research team has published over 60 international journal contributions over past 5 years and participated in over 10 competitive projects (national, European and non-European international).

RMIT

RMIT is a global university of technology, design and enterprise, ranked in the top 20 of universities under 50 years old in the world. World-class people, leading edge resources, collaboration with industry partners and multi-disciplinary approaches are just a few of the trademarks of research at RMIT, which boasts almost 90,000 students and campuses in Australia, Vietnam, a centre in Barcelona, Spain and research and industry partners on every continent.

The student will be integrated into RMIT Centre for Additive Manufacturing which is globally recognised Centre focusing on the industrial additive manufacturing. (<https://www.rmit.edu.au/research/centres-collaborations/centre-for-additive-manufacturing>) . The Centre is located in the CBD of Melbourne and houses state-of the art facilities with a total investment of \$40 Million. The RMIT Centre for Additive Manufacturing has five research themes and about 60 staff including 20 academics, 17 PostDocs and nearly 30 PhD students.

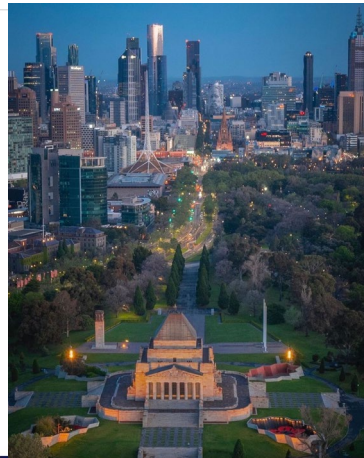
A short video highlighting the facilities is available at https://www.youtube.com/watch?v=hyIMixMj_qw

CAM Facilities

- [Advanced Manufacturing](#) (\$40m research and teaching facility)
- [RMIT's Microscopy and Microanalysis Facility \(RMMF\)](#) and
- [Micro Nano Research Facility \(MNRF\)](#)



Laser Powder Bed Fusion	Directed Energy Deposition	Industrial polymer printers	Subtractive manufacturing
4 SLM Solutions printers (2 single laser, 1 double, 1 quad)	TruLaser Cell 7020 3 kW laser (powder and wire) WAAM (arc plasma)	FDM, SLA, SLS J750 Colour 3D Printer Envisiontec 3D DLP Printer Fortus 900mc	5 and 6 axis CNC, wire cutting, welding, etc.



Source: City Melbourne

The PhD student will be working closely with:

A/Prof Andrey Molotnikov <https://www.rmit.edu.au/contact/staff-contacts/academic-staff/m/molotnikov-dr-andrey>

Prof Raj Das <https://www.rmit.edu.au/contact/staff-contacts/academic-staff/d/das-professor-raj>

The Centre has published over 180 papers in 2021 and actively participates in many national and international collaborations.

UPC

The Universitat Politècnica de Catalunya · BarcelonaTech (UPC) is a public institution of research and higher education in the fields of engineering, architecture, sciences and technology, and one of the leading technical universities in Europe. Every year, more than 6,000 bachelor's and master's students, more than 500 doctoral students graduate and 3,067 graduates in lifelong learning. The UPC has a high graduate employment rate: 93% of its graduates are in work and 76% find a job in under three months. It is ranked in the main international rankings.

The UPC has a wide spread presence in Catalonia, with nine campuses located in Barcelona and nearby towns: Castelldefels, Manresa, Sant Adrià de Besòs, Sant Cugat del Vallès, Terrassa, and Vilanova i la Geltrú.

The UPC is an International Campus of Excellence with two projects: the Barcelona Knowledge Campus (BKC) and the Energy Campus. Through these projects, it promotes employability, social cohesion and regional economic development. It interacts with research centres, science and technology parks, businesses and other agents as a hub for attracting talent in emerging research areas. In addition, through its four UNESCO Chairs, the UPC contributes to the exchange of knowledge and fosters cooperation.

The campuses are accessible, well connected by public transport and equipped with the necessary facilities and services to contribute to learning, research and university life.



UPC offers a wide range of training and mentoring opportunities to Doctoral Students including:

- Hola! Cultural and Language Reception Programme and the UPC Language Programme such as basic Catalan and Spanish courses. Visit this website for more information: <https://www.upc.edu/slt/en/language-and-terminology-service/our-services#newtocatalonia>
- MOOC courses
- Summer courses

A little more about you...

Functions to be developed by the PhD candidate

PhD candidate to be asked for sharing his/her R+D activity between CIMNE focusing on the **numerical simulation of metal Additive Manufacturing processes** and RMIT for the corresponding **experimental calibration/validation** of the model as well as to develop suitable **metallurgical models** to be integrated into the software platform

Requirements

- Excellent academic record.
- Advanced knowledge of **Continuum** and **Computational Mechanics** (master level).
- **Programming skills:** Fortran 2008 Object Oriented, Python, C.
- Windows and Linux OS
- Previous research or academic **experience in FE thermo-mechanical analysis**

It is also appreciated:

- Previous expertise in **microstructure** analysis and evolution, and **metallurgical modelling**.
- Previous experience in Parallel Computing (**HPC**)

Learn more on , , and on our website:

PhD enrolment. Successful candidates for this position will be enrolled by the following two universities:

Universitat Politècnica de Catalunya (UPC)

Admission

You will be enrolled as Doctoral Student at UPC for the entire duration of the assignment. At admission, you will need to supply:

- Degree certificate and the transcript of records of a Bachelor and Master (original and photocopy) in Engineering, Science or Technology and have completed a master's degree in a field related to the scientific area of the programme.

- Demonstrate basic knowledge in the field of Structural Analysis, particularly with regard to the mechanics of continuous media; solid and fluid mechanics; and linear, nonlinear, static and dynamic behaviour of materials and structures. It is recommended that candidates have some knowledge of programming (Computational Mechanics).

Homologation of a degree issued under a foreign education system is not required, but the UPC must verify that the degree certifies a level of training equivalent to an official Spanish master's degree and qualifies the applicant for admission to doctoral studies in the country where it was issued. Admission on this basis does not imply homologation of the foreign degree or its recognition for any purpose other than admission to doctoral studies. The academic committee will consider applications that do not meet these requirements on a case-by-case basis. In general, preference will be given to applicants who hold a master's degree in the sciences as defined in the Bologna Process guidelines. For the recognition of degree equivalency, the academic committee for the programme will assess to what extent the qualification in question corresponds to one of the master's degrees listed above in terms of the number of credits and the subjects studied. The academic standing of the institution that awarded the degree will also be considered.

Students who have completed one of the following UPC master's degrees qualify for direct admission to the doctoral programme in Structural Analysis and will not be required to take any bridging courses:

- Master's degree in Civil Engineering
- Master's degree in Numerical Methods in Engineering
- Erasmus Mundus master's degree in Computational Mechanics

Students who hold a master's degree or have completed postgraduate studies recognised by the UPC as equivalent to one of the masters degree's specified above will be admitted to the doctoral programme automatically. Candidates should demonstrate an interest in the research projects carried out within the framework of the programme; critical and analytical skills; initiative and perseverance in their academic work; the ability to work in a team; and the ability to communicate effectively, both orally and in writing.

More information: https://doctorat.upc.edu/en/programmes/structural-analysis?set_language=en

RMIT

Admission

You will also be enrolled as Doctoral Student at RMIT for the entire duration of the assignment. At admission, you will need to supply:

- CV
- Complete transcripts for all academic qualifications
- Research proposal or statement of interest in an available research project
- Language certificates
- List of referees

More information: <https://www.rmit.edu.au/research/research-degrees/how-to-apply>

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