PhD Position in Credible data-driven models: “Data-driven patient-specific reduced-order models supporting decision making in bioengineering” (VAC-2021-32)

Title of the PhD project: Data-driven patient-specific reduced-order models supporting decision making in bioengineering

INTRODUCTION:

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 Universitat Politècnica de Catalunya (UPC-BarcelonaTech), 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, the highest level of recognition of excellence and leadership awarded to a research centre in Spain.

POSITION DETAILS

Number of vacancies: 1
Category: PhD (PHD2)
Location: Barcelona
Yearly salary (gross): 17.563,14 EUR
Working hours: Full time
Duration: 3 years
Starting date: No later than Sept 2021

FUNCTIONS TO BE DEVELOPED BY THE APPLICANT

CIMNE is looking for a **PhD Researcher** to be part of the Research and Technical Development (RTD) Group on Credible data-driven models.

The functions assigned to the candidate will be:

- Complete a PhD on Civil Engineering at Universitat Politècnica de Catalunya – Barcelona Tech. The candidate is expected to complete the PhD thesis in a maximum of three years.
- Collaborate with various research groups within CIMNE and worldwide, namely Laboratory of Biological Structure Mechanics, Dept. of Chemistry, Materials and Chemical engineering “G. Natta”, Politecnico di Milano

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- To publish a minimum of two papers in JCR journals during the PhD period, author and co-author articles in high-impact international journals
- Carry out quality research, training and management.
- Participate on the dissemination and outreach activities associated with the project
- Participate in international conferences presenting her/his work

DESCRIPTION OF THE PHD PROJECT:

Numerical models are important tools for decision making in the broad field of biomedical engineering and, in particular, in computer-assisted surgery: from thrombectomy interventions [1] to cell mechanobiology and tissue engineering [2]. In this context, the systems and the phenomena to be modelled are extremely complex. The resulting computational models rely on a large number of input parameters (their values depend on the specific patient) and require using fine grids inducing high computational costs. Consequently, clinicians and experimentalists are, in practice, deprived of these models as a support for decision making. Moreover, the credibility of the results (associated with accuracy, robustness, and dispersion of the results) is jeopardized by the limited computational resources and the necessity of a prompt response. This calls for strategies that effectively reduce complexity and increase computational efficiency. Accordingly, this PhD project will be carried out in a strongly multidisciplinar environment (from Biomechanics to Computational Engineering) and will focus on developing, analyzing and implementing data-assisted parametric models of patient-specific vascular tissues and biocompatible structural devices. Emphasis is made on low-dimensional parametric models producing real-time responses [3,4], in front of parameter variations accounting for patient-specific features. A standard model might take hours or days of computational time, here we aim at seconds or minutes. The computational accuracy and credibility of the surrogate models devised in the project will be assessed using verification and validation strategies.

References

[1] Luraghi, G.; Rodriguez Matas, J.F.; Dubini, G.; Berti, F.; Bridio, S.; Duffy, Sh.; Dwivedi, S.; McCarthy, R.; Fereidoonnezhad, B.; McGarry, P.; Majoie, Ch.B. L.M.; Migliavacca, F., “Applicability assessment of a stent-retriever thrombectomy finite-element model Interface”, Focus.1120190123 (2020) https://doi.org/10.1098/rsfs.2019.0123

[2] Garcia, A.; Rodriguez Matas, J. F.; Raimondi, M. T. Modeling of the mechano-chemical behaviour of the nuclear pore complex: current research and perspectives. Integrative Biology, 8(10), 1011-1021 (2016)

[3] Sibileau, A.; García-González, A.; Auricchio, F.; Morganti, S. and Díez, P., “Explicit parametric solutions of lattice structures with Proper Generalized Decomposition (PGD): Applications to the design of 3D-printed architectured materials”, Computational Mechanics **62** (4), 871-891 (2018)

[4] Díez, P.; Zlotnik, S.; García-González, A.; Huerta, A.; “Encapsulated PGD Algebraic Toolbox Operating with High-Dimensional Data”, Archives of Computational Methods in Engineering, **27** (4), 1337-1362 (2020)

REQUIREMENTS

1. A bachelor and MSc degree (or equivalent) in Mathematics, Civil or Mechanical Engineering, Biomedical Engineering, Physics or a related field in a recognized high-education institution

2. A good command of English
3. An enthusiastic attitude to conduct research, being hard-worker and critic
4. Knowledge of programming languages such as Matlab, Python, Fortran
5. Familiarity and curiosity for data science and modelling.

EVALUATION OF CANDIDATES

The requirements and merits will be evaluated with a maximum mark of 100 points. Such maximum mark will be obtained by adding up the points obtained in the following items:

- Academic record (60%)
- Previous research and academic experience in the field of the position (20%)
- Programming skills (10%)
- Language skills (10%)

HOW TO APPLY

Candidates must complete the "Application Form" form on our website, indicating the reference of the vacancy and attaching the following documents **in English**:

- Curriculum vitae
- A motivation letter
- Academic transcripts from all Undergraduate and MSc degrees
- Name and institutional contact information of two possible referees

The deadline for registration to the offer ends on 31st May, 2021 at 12 noon.

The shortlisted candidates may be called for an interview. They may also be required to provide further supporting documentation.

CIMNE is an equal opportunity employer committed to diversity and inclusion. We are pleased to consider all qualified applicants for employment without regard to race, colour, religion, sex, sexual orientation, gender identity, national origin, age, disability or any other basis protected by applicable state or local law. CIMNE has been awarded the HRS4R label.