

PhD Position in Machine Learning in Civil Engineering Group and Flumen Institute (VAC-2021-21)

Title of the PhD project: Machine-Learning based prediction of floods

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: Madrid

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) Machine Learning in Civil Engineering Group and Flumen Institute.

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.
- 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 PDH PROJECT:

Flood prediction is essential in risk assessment to mitigate damages to population and goods. It has been traditionally addressed with physically-based methods, involving catchment-scale hydrological models to predict rainfall-induced runoff. These models need careful calibration of parameters, (e.g. Manning coefficient), but the lack of detailed information often leads to the use of simplifications which affect the accuracy of the results. They also require high computational resources and time, which prevents their use in real-time situations. By contrast, there is an increase in available information regarding discharge in different locations in many catchments, with increasing frequency of data acquisition and reliability. This, together with the development of machine learning algorithms, raised the interest in applying data-driven methods in this field, as proven by recent publication records.

The objective of the research is the development of a methodology for predicting flood discharge combining machine learning and physically-based methods (Iber software). This stems from the background of the proposing groups: while that of Machine Learning in Civil Engineering has a relevant background in applying machine learning in different areas, with focus on dam safety, Flumen leads the development of the Iber software, a standard in hydrological and hydraulic modelling. A preliminary initiative on the combined use of both techniques (neural networks in that case) dates from 2003, in the Ramflood European project. The idea fits with the research line in Water in the Generalitat-CIMNE Framework Programme.

References

Salazar, Fernando, et al. "An empirical comparison of machine learning techniques for dam behaviour modelling." *Structural Safety* 56 (2015): 9-17.

Cea, Luis, and Ernest Bladé. "A simple and efficient unstructured finite volume scheme for solving the shallow water equations in overland flow applications." *Water resources research* 51.7 (2015): 5464-5486.

Zounemat-Kermani, Mohammad, et al. "Neurocomputing in surface water hydrology and hydraulics: a review of two decades retrospective, current status and future prospects." *Journal of Hydrology* (2020): 125085.

REQUIREMENTS

1. Bachelor or MSc degree in Civil, industrial or environmental engineering.
2. Expertise in machine learning will be a plus.
3. Good programming skills.
4. Good working knowledge of English, written and spoken.

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.