

Call for a Master research fellowship in multiscale modelling with model order reduction of advanced materials in the scope of MSCORE Project

A position as Master Research fellow in multiscale modelling with model order reduction of advanced materials in the scope of the R&D project MSCORE «Multiscale modelling with model order reduction of advanced materials» NORTE-01-0145-FEDER-032419, co-financed by Fundo Europeu de Desenvolvimento Regional (FEDER) through Programa Operacional Competitividade e Internacionalização (COMPETE 2020) and Fundos Nacionais (PIDDAC) by FCT/MCTES under the NORTE-01-0145-FEDER-032419 project.

Title of the workplan:

Multiscale modelling with model order reduction of advanced materials.

Project Description:

This work proposal is to be achieved within the project MSCORE- Multiscale Methodology with Model Order Reduction for Advanced Materials and Processes. The project's overall goal is to develop a methodology that allows optimizing design and manufacturing processes of multiphase materials, using numerical models at different scales. These models should describe quantitatively relationships among geometry, processing variables, microstructure features, bulk properties and service performance. The novelty of the project lies in the integration of data from multiple variables along the manufacturing process by addressing the development of numerical models at different scales. From a digital representation of the material structure, a finite element model of a representative volume element (RVE) will be created to model the local behaviour of individual microstructure components. This will allow the determination of mechanical properties at the macro level, seen as a statistical response distribution from the phase distributions at the nano/micro dimensions. The multiscale method to be developed will characterize the influence of the microstructure on the macrostructure constitutive behaviour of the selected material, shedding light on the mechanisms that lead to defects during processing.

1. Duration and Regime of Activity:

With an estimated starting date in July 2018 and a duration of 6 months, this fellowship may be renewed until the end of the project (June 2021). The candidates have to work in exclusivity, according to the FCT Regulation for Studentships and Fellowships - 2018 and INEGI Regulation for Fellowships.

2. Workplan description:

The following tasks will be assigned to this Research work:

Task 1 - Digital material model

The main objective of this task is to build a digital material model of a Representative Volume Element (RVE), based on the finite element method that characterizes the material at the micro scale capturing the important geometric features of the microstructure, and physical properties of the different phases and boundaries. The digital material model should be based on experimental measurements obtained in other defined tasks within the MSCORE project by mapping the microstructure or creating a statistical equivalent. Model validation will be done by comparing the constructed digital model different topologies to the ones obtained by experiments on other tasks of MSCORE project and with literature results. In-house finite element codes and available commercial codes, namely Abaqus and DIGIMU®, from Transvalor S.A., will be used.

Task 2 - Multiscale modelling

The main objective of this task is to create a multi-scale model by providing the bridge between a

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macro-scale approach and the micro scale model developed in task 1. Computational homogenization techniques should be developed and adequate techniques to pass relevant information through different scales should be studied.

Task 3 - Model order reduction

The main objective of this task is to develop techniques to reduce the expected high computational costs by implementing model order reduction methods that can considerably reduce requirements of data storage and time. A data analysis method, the proper orthogonal decomposition (POD) should be explored, at the microscale level, aiming at capturing the dominant components of the full solution model by modal decomposition.

3. Work Place and Scientific Orientation:

The work will be undertaken at the INEGI facilities, Porto, Portugal under guidance of Prof. Abel D. Santos and Prof. José César de Sá.

4. Required academic background:

An applicant to this position must have a master's degree or equivalent in engineering, mathematics, applied / industrial mathematics, computational mechanics/physics, scientific computing, or a closely related field. Graduate level courses with excellent grades, including courses on numerical solution of ordinary- and partial differential equations, is a requirement, as well as good mathematical programming skills. The candidate should preferably have experience with finite element or finite volume simulations of thermomechanical systems. The candidate must have demonstrated experience with computational physics methods and preferably experience in developing simulation and analysis tools from scratch. Relevant candidates should have an interest for multidisciplinary research.

In addition to the required educational background, the following criteria will be evaluated: the grades, the quality of the master's thesis, the relevance and extent of completed course works, publications (if any), research and teaching experience, practical programming skills and experience. The candidate must be diligent and display the ability to work independently, supplemented with regular guidance, and is expected to carry out high-quality research and to publish the results in international workshops, conferences, and journals.

5. Fellowship allowance:

In accordance with the current values for a Scientific Research Fellowships in Portugal defined by FCT-Portuguese Foundation for Science and Technology (980 Euro per month), (www.fct.pt/apoios/bolsas/valores) paid at the end of the month by bank account transfer. Personal injury safety is also cover as is voluntary social security in the applicable cases.

6. Applicable Legislation and Regulation:

The fellowship contract will be celebrated according to the “Regulations for Research Grants of the Foundation for Science and Technology” currently in effect, to the INEGI Grant regulations approved by FCT, and to the Statute of Scientific Research Fellow Holder (Lei nº 40/2004 de 18 de Agosto, and its successive amendments) www.fct.pt/apoios/bolsas/docs/RegulamentoBolsasFCT2018.pdf.

7. Selection criteria:

The selection process consists of two phases: in the first phase a curricular evaluation will be done, with a 40% evaluation that will determine which candidates go to the second phase; The three candidates with the highest score in the first phase will pass to the second phase; the selected candidates will be called for an interview with the 60% evaluation in order to prepare an ordered list according to the specified criteria. The main selection criteria will be the scientific merit,

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the adequacy between the candidate's profile and the objectives of the scholarship, the motivation and relevant experience for the project in question, according to the admission requirements described above. Scholarships may not be awarded if candidates do not fulfill the requirements expected.

8. Selection Panel:

Prof. Abel D. Santos (PI), Prof. José César de Sá and Prof. Abílio M. P. de Jesus.

9. Notification of results:

The final results of the evaluation will be posted at www.inegi.up.pt

10. Application Documents:

- i) Motivation letter, demonstrating its adequacy to the required profile;
- ii) Curriculum Vitae;
- iii) Diploma(s)/Certificate(s) of Qualifications.

11. Application Deadline and Submission:

The call is open from **8th to 21st of June 2018**. Application documentation may be posted to the official INEGI's page at www.inegi.up.pt Work at INEGI | Available Positions, by clicking Send Application.

The Scholarship Support Office of INEGI is open Mondays to Fridays, 10:00 to 12:00 at the Human Resources Services.

INEGI

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