

Call for a research fellowship in numerical modelling of metal additive manufacturing In the scope of ADDing Project

A position as Master Research fellow in numerical modelling of metal additive manufacturing in the scope of the R&D project ADDing - «Multi-scale modelling of additive manufacturing by direct energy deposition of metallic powders», 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 POCI-01-0145-FEDER-030490 project.

Title of the workplan:

Multi-scale modelling of additive manufacturing by direct energy deposition of metallic powders

Project summary:

ADDing project, entitled Multi-scale Modelling of ADDitive Manufacturing by Direct Energy Deposition of Metallic Powders, aims the development of an integrated software tool for predictive analysis of 3D printed parts produced by direct energy deposition (DED) of metallic powders. Its novelty relies on the use of efficient computational methods for multiphysics modelling of DED at three distinct scales: part, powder and grain. This innovation will be attained by coupling FEM, CFD or meshless approaches. The numerical tasks will be supported by experimental tests, which will provide a full comprehension of DED phenomena (energy insertion, melt pool dynamics, microstructure evolution and residual stresses generation) and resultant material performance (thermal response, mechanical properties, shape distortion, etc.). Regarding impact, ADDing will contribute for a reduction of DED trials on the process optimization of each building job and, hence, to decrease the material and energy wastage.

1. Duration and Regime of Activity:

Duration of 6 months, extendable to the end of the project (June 2021), forecasted to start in July 2018 in exclusivity regime, according to the current regulation for Advanced Training and Qualification of Human Resources from the Science and Technology Foundation (FCT) in effect, <http://www.fct.pt/apoios/bolsas/regulamentos.phtml.en>, and INEGI's Fellowships Regulation.

2. Brief Description of the workplan:

The first task will be related to the development of a macro-scale thermomechanical model for DED. This should be implemented on a FE framework, based on the classical strong form equations for both thermal and mechanical problems and should account for the phase changes associated with the deposition of melted material and solidification. Relevant information on residual stresses, distortion effects and potential fracture zones should be obtained. Important features related with the material properties dependence on temperature should be periodically updated and, in particular, the geometry of the melt pool and temperature distribution should be acquired and improved from a mesoscale model.

The second task will be related to the development of a mesoscale model to study the complex heat transfer and phase change phenomena associated with the deposition process of powder and substrate using DED. Herein, the behaviour of single particles during the deposition process will be studied and some important aspects should be investigated regarding energy input from the laser beam, powder feed, surface roughness and properties of the substrate and deposition material. Other aspects should be addressed as the tracking the free surface movement on the melt pool and the evaporation process, which leads to energy and mass losses affecting the melt pool kinetics.

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3. Work Place and Scientific Orientation:

The work will be undertaken at the INEGI facilities, Porto, Portugal under guidance of Professor 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. Experience in predictive modelling of welding or laser-based processing techniques and in the use of computational dedicated software for process modelling (e.g., ESI SYSWELD, MSC Simufact Additive, etc.) will be advantageous.

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 method consists of two phases. In a first phase a curriculum evaluation (40% weight) will be performed to select candidates passing to a second phase; in a second phase the selected candidates will be interviewed (60% weight), with the purpose of producing an ordained list of selected candidates according to the specified selection criteria. Preferable selection criteria are: the scientific merit of the candidate; profile adequacy to the fellowship topics, motivation and relevant experience for the project of the call; sustained demonstration of good interpreting and writing capabilities in English. The jury reserves the right to voiding the call in case no suitable candidates are presented that satisfy the specified qualifications.

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8. Selection Panel:

Professor José César de Sá (PI), Professor Ana Rosanete Lourenço Reis e Doctor Maria Margarida Fernandes Machado.

9. Notification of Results:

Final results of the evaluation will be published online at www.inegi.up.pt

10. Application Documents:

- i) Presentation and motivation letter demonstrating adequacy to the requested profile;
- ii) *Curriculum Vitae*;
- iii) MSc degree certificate with a list of attended subjects (with grades).

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 RH ADDing UTAF 63/18.

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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