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**Call for a Research fellowship on residual stresses and fatigue strength assessment and modelling aiming enhanced AM components in the scope of AddStrength Project - Enhanced mechanical proprieties in additive manufactured components.**

A position as master research fellow on residual stresses and fatigue strength assessment and modelling aiming enhanced AM components is available at INEGI ([www.inegi.pt](http://www.inegi.pt)) in the scope of the R&D project AddStrength (POCI-01-0145-FEDER-031307), co-financed by Fundo Europeu de Desenvolvimento Regional (FEDER) through Programa Operacional Competitividade e Internacionalização (COMPETE 2020) and national funds through Fundação para a Ciência e a Tecnologia (FCT).

**Project Description:**

Current trend in additive manufacturing (AM) has been disrupting the traditional way of component design, allowing radical geometries with significant improvements in the specific residual strength of the component. This project aims (i) to investigate the effect of the residual stresses caused by the additive manufacturing processes on the fatigue life and residual strength of components and (ii) to create methodologies to improve the component strength through constructive residual stress fields. For these objectives, experimental measurements will be employed to assess residual stress for common additive layer manufacturing processes. Fatigue tests of representative specimens will be performed. In addition, computational models will be developed to evaluate the residual stress field considering manufacturing process parameters, allowing creating strategies for enhanced AM components.

**Title of the workplan:**

Residual stresses and fatigue strength assessment and modelling aiming enhanced AM components

**1. Duration and Regime of Activity:**

With an estimated starting date in October 2018 and 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 activities will be assigned to this research work:

**Activity 1 - Topology optimization in Additive Manufacturing**

This activity will deal with the current procedures used for topology optimization in additive manufacturing, with focus on fatigue design. Several examples, mainly from existing applications, will be examined in order to evaluate the stress concentration factors and stress gradients due to notches with low radius of curvature and other geometrical discontinuities. For this purpose, advanced finite element models will be made in order to guarantee mesh insensitivity for the calculated stress concentration factors. From the obtained results, additional conditions will be detailed for optimization procedures when fatigue strength is part for the component requirements.

**Activity 2 - Residual stresses promoted by additive manufacturing processes**

Residual stress fields are present in almost additive manufactured parts since most of AM processes use heat sources to promote the fusion and adhesion of the deposited material. This activity will evaluate the residual stresses for representative geometries, considering different additive manufacturing processes. The residual stress will be evaluated through the contour method in the relevant planes and/or synchrotron X-ray residual stress measurement.

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### Activity 3 - Computational modelling of AM processes

This activity aims to go forward in the AM processes modelling through the existing experience in applied welding simulation in order to predict residual stress (RS) fields and to optimize AM procedures to obtain constructive RS fields. For this purpose, existing state of the art commercial simulation tools will be used. Software with material database for metallurgical and mechanical properties as a function of temperature and capable to perform coupled analysis (e.g. comprising electromagnetism, heat transfer, diffusion and precipitations of chemical elements, phase transformations and thermomechanical phenomena) will be preferred. In addition, procedures to optimize the material deposition aiming at the production of constructive RS fields (as compressive RS in the component surfaces) will be developed using these models.

### 3. Work Place and Scientific Orientation:

The work will be undertaken at the INEGI facilities, Porto, Portugal under guidance of Prof. Abílio de Jesus and Doctor Sérgio Tavares.

### 4. Required academic background:

An applicant to this position must have a master's degree or equivalent in mechanical engineering, computational mechanics or a closely related field. The candidate should preferably have experience in numerical simulation of thermomechanical systems using finite element software or alternative tools. Relevant candidates should have an interest for multidisciplinary research and aptitude to tackle both numerical and experimental activities.

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](http://www.fct.pt/apoios/bolsas/valores)) paid at the end of the month by bank account transfer. Personal injury safety is also covered 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](http://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 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, the adequacy between the candidate's profile and the objectives of the scholarship, the motivation and relevant

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experience for the project in question, according to the admission requirements described above. Scholarships may not be awarded if candidates do not fulfil the requirements expected.

**8. Selection Panel:**

Prof. Doutor Pedro Camanho. Professor Abílio de Jesus, Professor José César de Sá, Doutor Sérgio Tavares.

**9. Notification of results:**

The final results of the evaluation will be posted at [www.inegi.up.pt](http://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 **12 to 25 September 2018**. Application documentation may be posted to the official INEGI's page at [www.inegi.up.pt](http://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**

Serviços de Recursos Humanos

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