**CALL DESCRIPTION**

**PUBLIC NOTICE**

**Title: COMPETITION FOR GRANTING ONE RESEARCH SCHOLARSHIP – 02/2023**

A tender is open for the attribution of one Research Scholarship within the scope of the Project INTENT "Intelligent health monitoring of road infrastructures using bender elements embedded in pavements", financed by "Fundação para a Ciência e a Tecnologia, I.P."/MCTES (FCT, I.P.), ref. 2022.06879.PTDC, through national funds (OE).

**Work Plan:**

RESEARCH SCHOLARSHIP– the work plan is developed at Lusófona University (https://civilresearchgroup.ulusofona.pt/) and CERIS Research Centre (https://ceris.pt/), both in Lisbon, Portugal, and consists of the following items: 1) Development of hybrid-Trefftz finite element models for transient wave propagation in geomaterials; 2) Development of fatigue degradation models for pavements; 3) Development of machine learning algorithms for damage detection; 4) Development of a toolbox for the automatic data acquisition and interpretation, damage progression forecast and early warning system for pavements. A summary of the Project INTENT can be found in the Appendix.

**Fellowship duration:**

The fellowship is for an initial period of 12 months, scheduled to start in July 2023. The scholarship contract may eventually be renewed up to a maximum duration of 33 months.

**Documentation to be provided when applying:** Applications must be formalized, obligatorily, by sending the following documents written in Portuguese or English, preferably, in PDF files:

- CV with indication of ORCID reference number;
- BSc Degree Certificate;
- MSc Degree Certificate;
- Motivation letter;
- Recommendation Letters (optional).

At least the MSc classification must be recognised by the Portuguese Authorities[1]. However, holders of foreign degrees may substitute the official recognition documents by a declaration of the candidate (link), stating that the candidate will present the recognition documents by the time the work contract is to be signed.

**Recipients' profile/category:** Master Degree holders in the following scientific areas: Civil Engineering, or Transportation Engineering, or Geotechnical Engineering, or Structural Engineering, or other related areas of interest to the project.

**Scientific Areas:**

[1] If the candidate does not already have the MSc degree recognized in Portugal, a fast-track recognition is possible for candidates with MSc degrees granted by Universities from the European Union, as well as the following countries: Andorra, Brazil (only degrees classified by CAPES with *conceito* equal or superior to 5), Moldova, Norway, Russia Federation, Switzerland, Turkey, Ukraine, United Kingdom. More details can be found here: https://www.dges.gov.pt/en/pagina/degree-and-diploma-recognition

Civil Engineering, Transportation Engineering, Geomechanics, Finite Element Method, Structural Health Monitoring.

**Application deadline:**
A tender is open from May 22 to June 5, 2023.

**Applicable legislation and regulations:**
Law No. 40/2004, of August 18, amended and republished by Decree-Law No. 202/2012 of August 27 (Statute of the Scientific Research Fellow) and amended by Decree-Law No. 233/2012 of October 29, by Law No. 12/2013 of 29 January, by Decree-Law No. 89/2013, of 9 July and Decree-Law No. 123/2019, of 28 August; Regulation of Research Grants of (https://www.fct.pt/apoios/bolsas/regulamento.phtml.pt).

**Workplace:**
The work is to be carried out at the facilities of the Lusófona University (Campo Grande, 376, 1749-024 Lisboa, Portugal) and CERIS Research Centre (Avenida Rovisco Pais, 1049-001 Lisboa, Portugal), under the scientific guidance of Professors Dragos Ionut Moldovan, Elói João Faria Figueiredo e José Coelho das Neves, being the contracting entity COFAC– Cooperativa de Formação e Animação Cultural CRL.

**Mandatory requirements:**
Candidates holding a master's degree in civil engineering, or Transportation Engineering, or Geotechnical Engineering, or Structural Engineering, or other related areas of interest to the project.

**Monthly maintenance allowance amount:**
The scholarship corresponds to the *Bolsa de Investigação* level of the table of scholarships awarded directly by FCT, I.P., in Portugal, with payment made monthly by bank transfer. The current stipend is set to €1199.64 per month.

**Selection criteria:**
The selection methods will be the following:
1. Scientific merit

70% for the final grade of the course, calculated according to the formula 0.5*U + 0.5*M, where U and M represent the classifications of the candidates at the Undergraduate (BSc) and Master (MSc) levels, respectively (for integrated Master (MI) the formula is 1*MI);
30% for publications (5 points for ISI journals, 2 points for non-ISI journals, 1 point for international conferences, 0.5 points for national conferences).

2. Interview

The first three candidates classified according to the scientific merit (SM) will be invited for an interview, for which a grade will also be awarded (I)
The final score of a candidate is computed according to the formula 0.7*SM + 0.3*I.
The jury may close the call without selecting any of the candidates if their qualifications are deemed too low to be acceptable.

**Composition of the Selection Jury:**
President of the Jury: Dragos Ionut Moldovan, PI of the INTENT Project
Effective members of the Jury:
Elói João Faria Figueiredo
José Coelho das Neves

**Form of advertising/notification of results:**
The candidates will be notified of the evaluation results proposed by the jury, up to 10 days after the deadline for the submission of applications, by email, with access to the jury report and the provisional ranking list.
After notification, candidates have 10 working days to comment on the draft decision (optionally, under the terms of the Code of Administrative Procedure). The final decision will be taken after the expiry of the prior hearing period, again notified to all candidates by e-mail. After this final decision the candidates can file a complaint within 15 working days (to the e-mail address used for the notification), or a hierarchical appeal, within 30 working days.

**Form of submission of applications:** Applications should be sent by email to dragos.moldovan@ulusofona.pt with subject: RESEARCH SCHOLARSHIP

APPENDIX

SUMMARY OF THE INTENT PROJECT

The expansion of road networks in regions with poor soils has led owners to call for improved and continuous monitoring solutions. Accurate and timely geotechnical information enable better planning of retrofit interventions, with huge savings to the €30B/year EU highway maintenance budget.
Currently, most pavement monitoring solutions are based on periodic inspections of the asphalt course. However, the pavement foundation (subgrade, capping, sub-base) and the granular base course are essential components of the road structure. The foundation acts as a construction platform for the upper layers and must sustain the traffic loads once construction is completed. Likewise, the base course sustains the construction of the asphalt course and spreads the loads to reduce the stresses in the foundation. The failure of the base course will inevitably compromise the pavement and is much harder to detect visually than the damage of the asphalt course.
Despite the importance of the unbound granular layers (sub-base and base), little quality assurance testing is carried out on the finished product and on its long-term behaviour. Continuous monitoring techniques have been proposed, but they are still in an incipient phase.

Instrumentation embedded in the granular layers includes strain gauges, to monitor their deformation; pressure cells, geophones and LVDTs to support the assessment of the stiffness; and temperature and moisture probes for ancillary measurements. No continuous monitoring technique has been reported to directly measure the dynamic stiffness of the geomaterial, despite this being highly relevant for damage detection.

The objective of this project is to develop a new embedded sensing device, based on the bender element technology, for the continuous monitoring of the dynamic stiffness (shear modulus) of unbound granular layers, and to use it, along with conventional sensors and advanced numerical models, to fuel machine learning algorithms for continuous monitoring of pavements.

The bender elements developed in this project enable the continuous measurement of the stiffness of the granular layers during construction, ensuring that pavement design requirements are met, and during the service life of the structure, enabling retrofit actions in the early stages of damage. They can be embedded in any layer with minimal disturbance, and their signal analysed automatically to extract the shear modulus of the layer. They can be coupled with conventional sensors to get a comprehensive picture of the condition of the layer, and the data analysed in real time by machine learning algorithms for damage detection. Advanced numerical models will help machine learning algorithms distinguish the between gradual loss of stiffness and/or gradual increase of permanent deformation under cyclic loading and the sudden, catastrophic deterioration of the geomaterial. A damage progression prognosis toolbox is developed to compare the expected and measured rates of degradation of the geomaterial and estimate its future condition.

Innovative coupled numerical-experimental techniques are used to power up these solutions. Hybrid-Trefftz finite element models are ideal for simulating the propagation of high frequency shock waves through geomaterials, as typical of bender element experiments. They are used to optimize the design of the bender element sensors and for the automatic interpretation of the output signal. A non-linear finite element model capable of simulating the strain accumulation and stiffness degradation under cyclic loading is used to inform machine learning algorithms on the expectable fatigue degradation patterns.

The project combines complementary competences and equipment from 6 research institutions in Portugal, Spain and USA. The team is experienced in finite element models, structural health monitoring, pavement engineering, dynamic behaviour of geomaterials, sensing and electronics.