

## CALL FOR GRANT APPLICATIONS (AE2024-0505)

INESC TEC is now accepting grant applications to award 1 Research Grant (BI) within the scope of the IBEX funded by National Funds through FCT - Portuguese Foundation for Science and Technology, I.P., project reference PTDC/CCI-COM/4280/2021.

### 1. GRANT DESCRIPTION

**Type of grant:** Research Grant (BI)

**General scientific area:** COMPUTER SCIENCE

**Scientific subarea:** Programming

**Area of Work:** Theory of Programming Languages

**Grant duration:** 5 months, starting on 2025-01-02, with the possibility of being renewed until the end of the project.

**Scientific advisor:** Renato Jorge Neves

**Workplace:** INESC TEC, Braga , Portugal

**Maintenance stipend:** € 990,98, [according to the table of monthly maintenance stipend for FCT grants](#) , paid via bank transfer. Grant holders may be awarded potential supplements, according to a quarterly evaluation process (Articles 19, 21 and 22 of the [Regulations for Grants of INESC TEC](#) and Annex II), up to a maximum limit of 50% of the monthly maintenance stipend.

INESC TEC supports costs with registration, enrolment or tuition fees, during the grant duration, under the terms established in the internal document: "[Payment of Tuition fees to grant holders](#)".

The grant holder will benefit from health insurance, supported by INESC TEC.

### 2. OBJECTIVES:

- Assistance in implementing a hybrid systems simulator based on exact real arithmetic (libraries for plotting, solvers of differential equations, visualisation mechanisms, etc);
- Analysis of different case studies in autonomous driving and their simulation in the prospective tool;
- Exercise the grantee's critical spirit in evaluating the research process and the results obtained;
- Exercise teamwork and communication.

### 3. BRIEF PRESENTATION OF THE WORK PROGRAMME AND TRAINING:

Hybrid systems combine continuous physical processes, such as temperature, time, and velocity, with discrete, event-based behaviours, such as assignments, conditionals, and state switching. Examples of such systems abound, and can be found in diverse critical domains. These include autonomous driving, modelling of biological systems, and medical and industrial engineering. It is therefore crucial that one can simulate their execution as effectively and precisely as possible. The simulation of hybrid systems, however, still harbours difficult challenges. A most prominent one arises from the ubiquitous use of floating-point arithmetic – it introduces errors and potentially leads to simulations that are completely different from the actual behaviour of the hybrid system at hand. Consequently the engineer may draw up wrong conclusions (e.g. the driving system is safe) which in turn can cause catastrophic failures.

The overarching goal of this project is to simulate hybrid systems via exact real arithmetic instead. More specifically the idea is to assist in the implementation of a simulator of hybrid systems, by implementing libraries for exact real arithmetic, plotting, visualisation, and analysis of differential equations. We expect that the performance of such a simulator will be worse than the standard counterpart (i.e. via floating-point arithmetic),

however in principle it will have much greater fidelity and this is of crucial importance in the critical domains mentioned above.

The language for writing down hybrid systems will be based on a while-language with differential constructs for specifying how a physical process behaves. The justification for this choice is that the language is simple, yet powerful, and moreover has a well-established semantics which we can use as an implementation guide. The implementation will be based on the programming language Haskell, due to the latter's laziness and higher-order features which is particularly useful in the context of exact real arithmetic.

#### 4. REQUIRED PROFILE:

##### Admission requirements:

MSc student in computer science or related field.

The awarding of the fellowship is dependent on the applicants' enrolment in study cycle or non-award courses of Higher Education Institutions.

##### Preference factors:

- Experience with functional programming (Haskell) and hybrid systems;
- M.Sc. course with focus on the two topics that were previously mentioned;
- High overall grade in the M.Sc. degree.

##### Minimum requirements:

- Experience with functional programming (Haskell) and hybrid systems;
- B.Sc. completed with overall grade  $\geq 16$ ;
- Current overall grade M.Sc. degree  $\geq 16$ .

#### 5. EVALUATION OF APPLICATIONS AND SELECTION PROCESS:

**Selection criteria and corresponding valuation:** the first phase comprises the Academic Evaluation (AC), based on the criteria referred to in Article 12 of the [Regulations for Grants of INESC TEC](#), while the second phase comprehends the Individual Interview (EI). All factors are evaluated on a scale of 0 to 100, taking into account the applicants' merit, suitability and conformity with the preference factors.

The weight of the AC factors are as follows: Academic Qualifications (FA, 50%), Scientific Publications (PC, 0%), Experience (EX, 30%) and Motivation Letter (CM, 20%).

Candidates who score less than 50 points in the AC average will be considered excluded on absolute merit. The top five candidates approved on absolute merit will be qualified for the individual interview. The Final Grade (CF) is obtained by the weighted average of AC (80%) and EI (20%).

#### DISABILITY INCENTIVE

Candidates who present a degree of disability equal to or greater than 90% will benefit from an incentive (20) in the score of the CV Assessment.

Candidates who present a degree of disability equal to or greater than 60% and less than 90% will also benefit from an incentive (10) in the score of the CV Assessment.

Said score may, in these cases, exceed 100 points.

Candidates must demonstrate the degree of disability during the application, namely through the submission of the Multi-Purpose Medical Certificate of Disability, issued in accordance with Decree-Law no. 202/96, of October 23 - currently in effect.

Candidates must declare, in the application form, the type of disability used throughout the selection process, in order to proceed with the required adaptations.

#### The Selection Jury is composed of the following members:

President of the Jury: Renato Jorge Neves

Full member: Luís Soares Barbosa

Full member: José Nuno Oliveira

Substitute member: José Paiva Proença

**Release of results and prior hearing:** the results of the selection process, as well as the terms and procedures for prior hearing, will be released to the applicants by email, under the terms referred to in Article 13 of the Regulations

for Studentships and Fellowships of INESC TEC.

## 6. FORMALISATION OF APPLICATIONS:

### Application Documents:

1. Motivation letter;
2. Curriculum Vitae (must include the list of previous fellowships, their type, beginning and end dates, funding entities and host institutions);
3. Certificate or diploma degree;
4. Proof of enrollment in a degree awarding study cycle or in a non degree awarding Higher Education program.
  - The proof of enrollment may be presented just during the grant hiring stage.
5. Signed declaration stating the infringement of the grant holder's duties (article 14, no. 4)
6. Documental evidence to support the country of residence, residence permit or other legally equivalent document, in cases where the applicant is a foreigner or non-resident in Portugal - valid until the beginning of the grant.
7. Other supporting documents relevant to the final assessment.

Failure to deliver the required documents within the 90-day period after the date of the notice of the conditional awarding of the grant implies its cancellation.

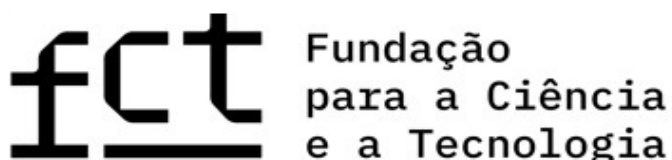
**Application period:** From 2024-11-29 to 2024-12-12

**Submission of applications:** the application will be formalised by submitting the form available in the *Work With Us* section of INESC TEC website.

## 7. BINDING LEGISLATION AND REGULATION

The hiring process shall comply with the current legislation regarding the Research Grant Holder Statute, approved by Law no. 40/2004 of August 18, in its current wording, as well as by the [Regulations for Grants of INESC TEC](#) and for [FCT Grants Regulation in force](#).

For more information, please check the [Regulations for Grants of INESC TEC](#) and relevant annexes at [www.inesctec.pt/bolsas](http://www.inesctec.pt/bolsas)



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