2 RESEARCH GRANT ANNOUNCEMENT (M/F)

Call open for applications for two research grants within the framework of project PTDC/EEI-AUT/3522/2020 - RELIABLE - Advances in control design methodologies for critical safety systems applied to robotics, funded by national funds (PIDDAC) through FCT/MCTES, under the following conditions:

Scientific Area: Electrical and Computer Engineering, Computer Engineering, Mechanical/Mechatronics Engineering or in related fields.

Admission requirements: Candidates who cumulatively meet the following two requirements may apply for this grant:

Requirement 1

Be a student enrolled in a PhD in one of the following areas: Electrical and Computer Engineering, Computer Engineering, Computer Science, Applied Mathematics or in related fields; This requirement must be duly proven at the time of signing the contract.

Or

Holder of an academic degree enrolled in a non-academic degree course integrated in the educational project of a higher education institution, developed in association or cooperation with one or more R&D units, requirement to be duly proven at the time of signing the contract.

Note: In the case of masters who are enrolled in non-academic degree courses, the scholarship can only be awarded to those who do not exceed, with this scholarship contract, including possible renewals, an accumulated period of two years in that typology of the scholarship, followed or interpolated.

And

Requirement 2

Hold a master's degree in Electrical and Computer Engineering, Computer Engineering, Mechanical/Mechatronic Engineering or in related fields.

If the degree has been awarded by a foreign higher education institution, it must comply with the provisions of the Decree-Law no. 66/2018, of august 16th, and any formalities established there must be fulfilled until the time of signing the contract.

Activity Outline:

In this project, we address a specific area related to the methodological/conceptual part at the algorithmic level of designing automation and control systems. The objective is to develop methodologies and algorithms for control systems directly incorporating security requirements into the problem formulation, guaranteeing (mathematically) security certificates. To that end, a specific objective is to combine data-oriented approaches and machine learning techniques (known as unreliable and/or extremely difficult to obtain formal guarantees) with recent techniques based on control and optimization, capable of imposing invariance properties on the context of barrier control functions (CBFs) and Lyapunov control functions (CLFs) in the presence of complex constraints and uncertainties.

Another objective is to extend the mentioned concepts to critical network security systems (possibly large scale), involving several agents operating autonomously in networks in dynamic environments, where in this case additional challenges arise due to the presence of a communication network. In this case, we will investigate the following crucial aspects: i) how to design control strategies to detect and/or isolate defective agents and malicious attacks, ii) how to improve robustness under defective and/or malicious agents in relation to the controllability and observability properties of the global system, and how to improve the resilience of consensus processes, covering

in this way a wide range of applications (distributed optimization, movement coordination tasks, among others).

The project is mainly dedicated to conceptual aspects, but will also illustrate and demonstrate applications of critical safety systems, focusing on the following case studies:

- Robotic vehicles in space, air and underwater scenarios: The scenarios considered are related to remote monitoring and exploration operations that require high-performance control systems and are critical in the sense that the consequences of failure can lead to the loss of expensive equipment. An example to be studied is the development of trajectory planning algorithms for jumping robots that traverse rough terrain on large celestial bodies (such as planets and moons) in safe (possibly disconnected) and unsafe regions. Other important topics to investigate include the development of location, navigation and movement control strategies for single or multiple autonomous underwater vehicles and fixed wing unmanned aerial vehicles with safety guarantees. Here, the intention is to go beyond the development of algorithms, but also to test them in realistic digital simulators and field experiments.

- Mobile robotics in industry 4.0 scenarios: The objective is to contribute to the development of innovative solutions in the industry, with special emphasis on logistics and cooperative scenarios between workers and mobile robotic vehicles. The main points to be addressed include the development of active and high-performance perception algorithms, reactive planning, navigation, and control systems that allow mobile robots to operate autonomously in unstructured environments, with effective human-robot collaboration and safety guarantees.

The fellows will be integrated in the Research activity of the RELIABLE project team, with the objective of formally demonstrating the security, robustness, and stability of the developed algorithms, through simulation, testing, validation, and integration in software tools for command and control of mobile robotic systems, being directly involved in the following tasks:

[Position B2]

- Task 2 - Control Lyapunov Functions (CLF) and Control Barrier Functions (CBF) design methodologies
- Task 6 - Dissemination and exploitation of the results

[Position B3]

- Task 3 - Critical Safety Networks Design Methodologies
- Task 6 - Dissemination and exploitation of the results

Legislation and regulations: Law Nº. 40/2004, of 18th August, in its current wording (Statutes of Scientific Research Fellow) and Regulation of Research Grants of Fundação para a Ciência e a Tecnologia, in force (https://www.fct.pt/apoios/bolsas/regulamento.phtml.pt) and Regulation of Research Grants of University of Porto, in force.

Workplace: The work will be developed at the Department of Department of Electrical and Computer Engineering of the Faculty of Engineering of the University of Porto (FEUP), under the scientific supervision of Professor António Pedro Rodrigues Aguiar.

Grant duration: Initial duration of **6 months**, with the predicted starting date in **December 2022**, on an exclusive basis eventually renewable but **never exceeding the project duration**. The eventual renewal of the scholarship will be carried out as determined in article 6 of the Research Grants Regulation of the Foundation for Science and Technology, I.P.

Stipend: The grant stipend amounts to 1.144,64 € according to the table of values of the grants awarded directly by FCT, I.P. in the Country (https://www.fct.pt/apoios/bolsas/valores). The payment will be made by bank transfer.

Selection procedure: Candidates will be graded on a scale of 1 to 5 points. A curricular evaluation (60%) will be carried out, which will focus on the candidate's merit, in which the following factors will be considered:

Curricular evaluation classification = (30%* AC1) + (30% * AC2) + (40% * AC3)

a) AC1 - Academic training:

- Master's Degree in Electrical and Computer Engineering, Computer Engineering, Mechanical/Mechatronics Engineering or in related fields relevant to the project - 5 points;
- Other Masters - [≥ 0 and < 5] points;

b) AC2 - Master's final average:

- [≥ 17 values] – 5 points;
- [≥ 15 and < 17 values] – [≥ 4 and < 5] points
- [≥ 13 and < 15 values] – [≥ 3 and < 4] points
- [< 13 values] – 2 points;

c) AC3 – Research experience:

- in the project area – [≥ 4 and ≤ 5] points;
- in areas related to the project – [≥ 2 and < 4] points;
- outside the project area – [≥ 0 and < 2] points;

After analyzing the submitted documentation, the Selection Jury will interview the 3 best classified in the curriculum evaluation, and candidates who obtain a score lower than 3.5 points will not be admitted to the interview.

In the interview (40%), topics related to the work plan, previous experience, motivation, and the candidate's CV will be discussed, where the following will be verified:

Interview classification = (60%* EC1) +(20% * EC2) +(20% * EC3)

E-C1 - Knowledge and motivation for the exercise of the function:

- Excellent knowledge and motivation – [≥ 4 and ≤ 5] points;
- Good knowledge and good motivation – [≥ 1 and < 4] points;
- Lack of knowledge or motivation – [≥ 0 and < 1] points

E-C2 - Attitude (evaluates the candidate's behavior in terms of ability to work in a team, ability to manage conflicts, capacity for persuasion, presentation and confidence)

- Excellent attitude – [≥ 4 and ≤ 5] points;

- Adequate attitude – [≥ 1 and < 4] points;

- Inappropriate attitude – [≥ 0 and < 1] points

E-C3 - Capacity of expression and verbal fluency in Portuguese and/or English (coherence and discursive clarity, vocabulary richness, ability to understand and interpret the questions asked).

- Very good ability to express, communicate or interpret – [≥ 4 and ≤ 5] points;

- Good ability to express, communicate or interpret – [≥ 1 and < 4] points;

- Difficulty in expressing, communicating or interpreting – [≥ 0 and < 1] points;

The final classification of the interviewed candidates will result from the sum of the classifications obtained in the Curriculum Assessment (AC) and Interview (E), giving each factor the weight of 60% and 40%, respectively:

Final classification = (60%* AC) +(40% * E)

The right not to hire is also reserved if the candidate with the best final classification does not obtain a classification equal to or greater than 4 points.

Selection Jury:

President: Prof. Dr. António Pedro Rodrigues Aguiar

Effective member: Prof. Dra. Maria do Rosário Marques Fernandes Teixeira de Pinho

Effective member: Prof. Dr. João Tasso Figueiredo Borges de Sousa

Supplementary member: Dr. Roman Chertovskikh

Advertisement of final decision: The results of the evaluation will be released to the candidates by email to the email address indicated in the application process.

Deadline for applications and form of presentation of the applications:

The call is open from 17-11-2022 to 30-11-2022 (until 23h59m, GMT time).

Applications must be formalized by email to apra@fe.up.pt, sas.systec@fe.up.pt and to recursoshumanos@fe.up.pt , clearly stating the reference (**FEUP-RELIABLE-B2|B3**) accompanied by the following documents: Motivation letter, copy of the qualification certificate (referring to the course average - of each cycle or integrated cycle – and, if possible, classifications in the curricular units), Detailed Curriculum Vitae, Declaration on honor that the candidate fulfills the requirement contained

in article 6 of the Regulation for Research Grants of the Foundation for Science and Technology, I.P. (model below, for student enrolled in a non-academic degree course integrated in the educational project of a higher education institution, developed in association or cooperation with one or more R&D units) and other documents considered relevant by the candidate.

To guarantee the reading of all documents, the preferred recording format is the Portable Document Format (.pdf).

DECLARATION ON HONOUR

I, (identification of the scholarship holder), holder of the Citizen Card / Visa / Residence Permit no. valid until _____, declare under honour, to be in the conditions of no. 5 of article 6º of the Research Grants from FCT, IP - Regulation No. 950/2019, of 16 December.

Oporto, ___/___/_____

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(Signature of candidate)