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CALL FOR AWARDING RESEARCH FELLOWSHIPS WITHIN PROJECT GRANTS AND R&D INSTITUTIONS

1 Research Fellowship for R&D Initiation (BII)

1 Research Fellowship(s) for R&D Initiation (BII) is(are) open at the **FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências**, for the project/R&D institution "Instituto de Biofísica e Engenharia Biomédica", "Special support Summer with Science 2022", funded by the Fundação para a Ciência e a Tecnologia, I.P./MCTES through national funds (PIDDAC) under the programme "Special support for scientific and technological research activities in R&D units", under the following conditions:

1.   **Scientific Area**: Medical Microwave Imaging of the breast, Classification-aided Microwave Imaging, Biomedical Engineering and Biophysics (Engenharia Biomédica e Biofísica)

2.   **Requirements for admission**: Must have a Bachelors' degree (or 1st cycle of the Integrated Masters) in Biomedical and Biophysics Engineering. Must have participated in outreach activities and projects related to the topic of this call.

3.   **Additional optional skills and qualifications**: Proven knowledge in Matlab, Python, including Scipy, also proven knowledge with operation with Vector Network Analysers (Keysight preferred) and ultra-wide band antennas for medical applications.

4.   **Contracting requirements**: Presentation of the academic qualifications and/or diplomas. Enrolment in Masters Biomedical Engineering and Biophysics (https://fenix.ciencias.ulisboa.pt/degrees/mebb).

5.   **Work plan**: Microwave Imaging (MWI) emerges as a low-cost alternative to current breast cancer diagnostic techniques [1]. While the resolution of these images is relatively low, microwave imaging offers some significant advantages, including: no compression of body tissues (quite relevant in the context of breast imaging), the use of only non-ionising radiation, and its non-invasive nature. MWI uses only low-power levels, and has potentially low installation, operation, and maintenance costs. However, it has a limited resolution, which can lead to a high rate of false negatives and false positives, commonly observed with state-of-the-art beamforming algorithms.
In this project, an alternative to beamforming is proposed, namely a Classification-Aided Imaging (CAIm). Dedicated feature extraction methods will be developed, and then combined with classification algorithms (namely Machine Learning) to estimate the likelihood of a given voxel in a resulting image corresponding to a healthy tissue (a "miss") or a tumour tissue (a "hit"). The resulting CAIm may be used as a standalone or in combination with a beamformed image to highlight additional information that the former brings to the latter. For example, our proposed CAIm may reduce false-positive responses in microwave images, or alternately may be used to highlight false-negative responses.
Task 1. Signal acquisition
The breast phantoms will be placed on a cup-shaped support with 25 openings for the antennas. Our MWI system can hold up to 9 antennas that emit in the 2-6 GHz band. In this way, different configurations for the position of the antennas will be tested.
Each of the 57 breast+plug phantom is positioned in the MWI system and signals will be collected for various antenna configurations.
Task 2. Signal processing

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Given that the tumor is in a known position, we will be able to filter time-gated sections of each collected signal (i.e. a synthetic focal point) as part of the "tumor" or "healthy" tissue. From the measured signals, data mining will be carried out to remove the most relevant features for signal classification. The group has already carried out a survey of 27 features that will be the starting point of the project. The presented features include mean, variance, standard deviation, area under the curve and peak detection (in terms of maximum and minimum amplitudes).

The classifiers will determine whether a given focal point belongs to a healthy tissue, which is classified as a "miss", or to tumour tissue, which is classified as "hit". Each synthetic focal point is calculated as the probability of tumour occurrence, resulting in a "probabilistic map" of the breast. The classifier will assign a value between 0 or 1 to each point in the breast energy profile, with values closer to 0 should correspond to a "healthy" point (a "miss") and values closer to 1 should correspond to a "tumor" point (a "hit"). Several classification algorithms will be tested, including: Support Vector Machines (SVM), K-Nearest Neighbours (KNN) and/or Random Forests (RF).

6.   **Legislation framework**: Research Fellowship Holder Statute, in accordance with Law 40/2004, of 18 August, in its current version and the FCT Regulation for Research Studentships and Fellowships, in its current version (Reg. 950/2019 published in DR on 16th December: https://dre.pt/application/file/a/127230968, or at the FCT website: https://www.fct.pt/apoios/bolsas/regulamento.phtml.pt), and FCiências.ID Fellowship Regulation, as approved on 12th May 2020 (available at Regulamento de Bolsas de Investigação Científica da FCiências.ID).

7.   **Place of work**: The work will be developed at the Instituto de Biofísica e Engenharia Biomédica under the scientific supervision of Professor Dr. Raquel Cruz Conceição.

8.   **Fellowship duration**: This position is initially opened for 1 month due to start in August 2022.

9.   **Monthly allowance**: The fellowship amounts to € 486.12 ,according to table values of the fellowships awarded directly by the FCT, IP. The fellowship holder will have a personal accident insurance and can ensure the right to social security through adherence to the voluntary social insurance scheme, if not covered by any other social protection scheme, pursuant to *Código dos Regimes Contributivos do Sistema Previdencial de Segurança Social.*
The fellowship will be paid monthly by bank transfer.

10.   **Evaluation and selection process**: Candidates will be assessed by Grade achieved in Bachelors in Biomedical Engineering and Biophysics (A), CV (B), motivation letter (C), Interview – optional (D). All criteria are graded in the scale 0-20, as described below.

Criterion A – Grade achieved in the Bachelors in Biomedical Engineering and Biophysics (or 1st cycle of Integrated Masters in Biomedical Engineering and Biophysics), percentage weight of 30%;
Criterion B - CV, with emphasis on academic experience, internship, ongoing Masters project, work experience, percentage weight of 30%;
Criterion C – Motivation letter demonstrating the suitability of the candidate to the project, percentage weight of 40%
Final Grade = (30%×A) + (30%xB) + (40%×C)

If there is more than one candidate with the same final grade, the candidates will be ordered based on the highest

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grade in criterion C, followed by criterion B, followed by criterion A. If required, an interview (D) will take place, and a weight of 30% will be attributed.

Applicants whose application is scored with a final classification of less than 17 points are not eligible for granting a fellowship.

11.   **Selection Committee**:

President of jury: Prof. Alexandre Andrade, Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016-Lisboa

Member of jury 1: Dr. Sofia Fernandes, Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016-Lisboa

Member of jury 2: Dr. João Miguel Pinto Coelho, Instituto de Biofísica e Engenharia Biomédica & Laboratório de Óptica, Lasers e Sistemas, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016-Lisboa

Alternate member of jury 1: Prof. Brígida Ferreira, Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016-Lisboa

Alternate member of jury 2: Prof. Nuno Matela, Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016-Lisboa.

12.   **Publication/notification of results**: All the candidates will be notified by e-mail, sent by the call holder, with the selection meeting minutes enclosed.

13.   **Deadlines**: This call for applications is open from 28/07/22 to 03/08/2022 .

14.   **Application:** Applications should be sent via e-mail to rcconceicao@fc.ul.pt, by attaching the following documents:
    a.   Curriculum vitae **- CV may be provided in PDF or through the CIÊNCIAVITAE system**;
    b.   Certificate of completion of previous degree (if the certificate is not available yet, proof that the certificate was requested and proof of grade or a declaration of honour will be accepted);
    c.   Motivation letter.

15.   **Time limits for the appeal procedure:** In case of negative decision, the candidates have 10 business days, after the date of announcement of the results of the candidates evaluation, to pronounce their disagreement in accordance with the *Código do Procedimento Administrativo*. Appeals against the final decision may be submitted to the Administration Board of FCiências.ID (fciencias.id@fciencias-id.pt) within 15 business days after the notification date

Note 1: The documents that prove the entitlement of the academic qualifications and diplomas, or the proof of registration in the academic degree or diploma requested on the call, can be dismissed during the application period and replaced by a declaration on their honour from the applicant. Their delivery is mandatory for the fellowship contractualization.

Note 2: Please note that - higher education degrees and diplomas awarded by foreign higher education institutions need to be recognized by a Portuguese higher education institution, pursuant to the Decree-Law nr. 66/2018 (August 16) and the Ministerial Order nr. 33/2019 (January 25). The presentation of the recognition certificate is mandatory for contract signature. More information can be obtained at: https://www.dges.gov.pt/en/pagina/degree-and-diploma-recognition.

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