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MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2015

PART B

"proposal ACRONIM"

This proposal is to be evaluated as:

Standard EF

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0 LIST OF PARTICIPANTS

Participants	Legal Entity Short Name	Academic	Non-academic	Country	Dept. / Division / Laboratory	Supervisor	Role of Partner Organisation
Beneficiary							
Universitat de Girona	UdG	✓		Spain	Computer Vision and Robotics institute (Vi-COROB)	Dr. Joan Martí	
Partner Organisation							
Florida State University	FSU	✓		USA	Scientific Computing	Dr. Anke Meyer-Baese	Host Outgoing phase
UDIAT - Centre Diagnòstic - Institud Universitari Parc Taulí - UAB	UDIAT		✓	Spain	Dept. of breast and gynaecological radiology	Dr. Melcior Sentís	image acquisition, expert radiologist's feedback and clinical validation

Data for non-academic beneficiaries

Name	Location of research premises (city / country)	Type of R&D activities	No. of fulltime employees	No. of employees in R&D	Website	Annual turnover (approx. in Euro)	Enterprise status (Yes/No)	SME status (Yes/No)
UDIAT - Centre Diagnòstic - Institud Universitari Parc Taulí - UAB	Sabadell, Spain	Medical research	350	2	www.tauli.cat/udiat/	15 millions	yes	no

ummary

1 SUMMARY

Breast cancer is the leading cause of cancer deaths among females worldwide.This has motivated the establishment of Breast Screening PolicyBreast Screening Policies (BSPBSPs) to facilitate breast cancer detection at an early stage. Despite X-ray Digital Mammography (DM) is considered the gold standard technique for BSP, other screening techniques like Ultra-Sound (US) and Magnetic Resonance Imaging (MRI) are being investigated to overcome DM limitations due to tissue superposition which can either mimic or obscure malignant pathology, and avoid X-ray radiation all together.

From the different DM alternatives, the most promising to overcome the aforementioned limitations is MRI. However, Non-mass-like enhancings (NMLEs) lesions exhibit a heterogeneous appearance in breast MRI with high variations in kinetic characteristics and typical morphological parameters, and resulting in a lower reported specificity (69%) and sensitivity (75%) than mass-enhancing lesions. Combinations of morphological and temporal BI-RADS descriptors have proven to be insufficient to aid in the automated differential diagnosis of these lesions in Contrast-Enhanced MRI (CE-MRI). Newest clinical studies suggest that T2-weighted image sequences and Diffusion-Weighted Imaging (DWI) may provide additional specificity.

The aim of this fellowship is to translate these findings into a new Computer Aided Diagnosis (CAD) system. Our hypothesis is that a combination of novel descriptors extracted from multiparametric breast MRI has the potential to substantially improve the diagnostic value of the detection and classification of NMLEs.

This first and novel CAD system in multiparametric breast MRI will reduce false positive recalls and thus increase specificity. A reduction in recall of only 5% would already be clinically relevant, considering the costs and patient discomfort associated with second look ultrasound examinations and biopsies.

The experience of ViCOROB in Breast-CAD, the preliminary studies in multispectral MRI carried out in FSU at the scientific computing division, and the clinical support from UDIAT guarantee the success of this project as well as the correct transfer of knowledge from the laboratory to the clinical site. It is also planned to commercialise the output CAD tool to clinical sites through existing medical imaging companies or via a spin-off.

The specific aims of this proposed project are to:

Aim 1:

Develop an image regularization framework for multiparametric breast MRI that includes a novel simultaneous elastic registration and segmentation algorithm. ***Impact:*** *This methodology is fundamental for a correct image regularization and dramatically impacts the correct subsequent detection and diagnosis of NMLE lesions.*

Aim 2:

Develop and apply novel image descriptors for characterizing lesion heterogeneity in T2-weighted MRI and DWI. ***Impact:*** *A combination of these image descriptors may increase the diagnostic value of existing CAD systems in breast MRI.*

Aim 3:

Develop spatio-temporal feature extraction algorithms in CE-MRI. ***Impact:*** *These algorithms from Aim 2 and 3 will facilitate the categorization of NMLEs lesions.*

Aim 4:

Evaluation of the CAD system in terms of performance compared to trained readers and gold standard. ***Impact:*** *Radiologists can benefit from this system by reduced interobserver variation and improved interpretation of breast MRIs for the presence or absence of malignant non-mass-like enhancing lesions.*

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2 EXCELLENCE

2.1 Quality, innovative aspects and credibility of the research

Introduction to breast cancer and multiparametric MRI Breast cancer has significant impact on the well-being of the female population worldwide. This disease represents the leading cause of cancer death among

females worldwide[1]. This has motivated the establishment of BSPBSPs to facilitate breast cancer detection at an early stage. Despite X-ray DM is considered the gold standard technique for BSP, other screening techniques like US and MRI are being investigated to overcome DM limitations due to tissue superposition which can either mimic or obscure malignant pathology, and avoid X-ray radiation all together.

Though MRI is a promising alternative to DM, NMLE lesions exhibit an heterogeneous appearance in breast MRI with high variations in kinetic characteristics and typical morphological parameters[2], and have a lower reported specificity (69%) and sensitivity (75%) than mass-enhancing lesions[3] in CE-MRI. The diagnosis of NMLE lesions is thus far more challenging.

Malignant lesions such as Ductal Carcinoma in Situ and Inflating Lobular Carcinoma commonly exhibit a segmental or linear enhancement pattern and benign lesions such as fibrocystic changes present as well a NMLE[4]. However, a systematic classification of NMLE lesions is not in place. A classification of such lesions would be highly beneficial since they may reduce the biopsies' numbers. Recently, there have been new research initiatives to assess NMLE lesions using multiparametric MRI which combines T1-weighted contrast-enhanced MRI with diffusion-weighted imaging (DWI)[5]. It was shown that the combination of morphological, functional and molecular information offered by multiparametric MRI improves the diagnostic accuracy of breast cancer diagnosis. Another study showed that T2-weighted imaging can better represent the morphological features of small lesions[6] and combined with DWI it increased the diagnostic performance of MRI.

Computer-aided analysis showed a much lower sensitivity (0.79 vs. 0.97) and specificity (0.56 vs. 0.8) for NMLE lesions compared with masses and suggested the need for more advanced algorithms for the diagnosis of NMLE[7]. Uniformity, and a clear set of imaging descriptors for the reporting of T2 and DWI features of NMLE is lacking. Furthermore, there is no quantitative technique for how to combine the morphological, functional and molecular information derived from multiparametric imaging.

The bottleneck that remains for providing an improved differential diagnosis of NMLE lesions and thus contribute to advancing CAD systems beyond the current level are determining descriptors that incorporate the diagnostic information from multiparametric MRI. **Our proposal to develop advanced image analysis algorithms to improve the differential diagnosis of the challenging NMLE lesions would provide the radiologist with a fast and accurate computational diagnosis support.**

2.2 Clarity and quality of transfer of knowledge/training for the development of the researcher in light of the research objectives

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2.3 Quality of the supervision and the hosting arrangements

vision

Required sub-heading:

Qualifications and experience of the supervisor(s)

Career development Employers and/or funders of researchers should draw up, preferably within the framework of their human resources management, a specific career development strategy for researchers at all stages of their career, regardless of their contractual situation, including for researchers on fixed-term contracts. It should include the availability of mentors involved in providing support and guidance for the personal and professional development of researchers, thus motivating them and contributing to reducing any insecurity in their professional future. All researchers should be made familiar with such provisions and arrangements.

[1] cancerStatistics2011 Ahmedin Jemal et al. "Global cancer statistics". In: *CA: A Cancer Journal for Clinicians* 61 (2011).

[2] **skamato2008categorization**; rosen2007birads Eric L Rosen et al. "BI-RADS MRI Enhancement Characteristics of Ductal Carcinoma In Situ". In: *The breast journal* 13.6 (2007), pp. 545–550; yabuuchi2010nmle Hidetake Yabuuchi et al. "Non-mass-like enhancement on contrast-enhanced breast MR imaging: lesion characterization using combination of dynamic contrast-enhanced and diffusion-weighted MR images". In: *European journal of radiology* 75.1 (2010), e126–e132.

[3] **Vag**.

[4] **Vag**.

[5] **Pinker1**; yabuuchi2010nmle Yabuuchi et al., "Non-mass-like enhancement on contrast-enhanced breast MR imaging: lesion characterization using combination of dynamic contrast-enhanced and diffusion-weighted MR images".

[6] **Wu1**.

[7] **Newell**; **Vag**; **Jansen1**; **Jansen2**.

turity

2.4 Capacity of the researcher to reach and re-enforce a position of professional maturity in research

impact

3 IMPACT

3.1 Enhancing research- and innovation-related human resources, skills, and working conditions to realise the potential of individuals and to provide new career perspectives

cement

In this section, please explain the impact of the research and training on the Experienced Researcher's career. The fellowship, including any secondments in Europe should maximise the impact on the researcher's activity on European society, including the science base and/or the economy, in a manner appropriate to the research field.

3.2 Effectiveness of the proposed measures for communication and results dissemination

Required sub-headings:

Communication and public engagement strategy of the action
Dissemination of the research results
Exploitation of results and intellectual property

Concrete plans for the above must be included in the Gantt Chart. The new knowledge generated by the action should be used wherever possible to enhance the career of the researcher, to advance research, to foster innovation, and to promote the research profession to the public. The following sections of the European Charter for Researchers refer specifically to public engagement and dissemination:

Public engagement Researchers should ensure that their research activities are made known to society at large in such a way that they can be understood by non-specialists, thereby improving the public's understanding of science. Direct engagement with the public will help researchers to better understand public interest in priorities for science and technology and also the public's concerns.

Dissemination, exploitation of results All researchers should ensure, in compliance with their contractual arrangements, that the results of their research are disseminated and exploited, e.g. communicated, transferred into other research settings or, if appropriate, commercialised. Senior researchers, in particular, are expected to take a lead in ensuring that research is fruitful and that results are either exploited commercially or made accessible to the public (or both) whenever the opportunity arises.

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4 IMPLEMENTATION

4.1 Overall coherence and effectiveness of the work plan

The proposal should be designed in the optimal way to achieve the desired impact. A Gantt Chart should be included in the text where the following should be listed:

- Work Packages description;
- List of major deliverables;
- List of major milestones;
- Secondments if applicable.

The schedule should be in terms of number of months elapsed from the start of the project.

4.2 Appropriateness of the management structure and procedures, including quality management and risk management

Develop your proposal according to the following lines:

- Project organisation and management structure, including the financial management strategy, as well as the progress monitoring mechanisms put in place;
- Risks that might endanger reaching project objectives and the contingency plans to be put in place should risk occur.

The following could be also included in the Gantt Chart:

- Progress monitoring;
- Risk management;
- Intellectual Property Rights (IPR).

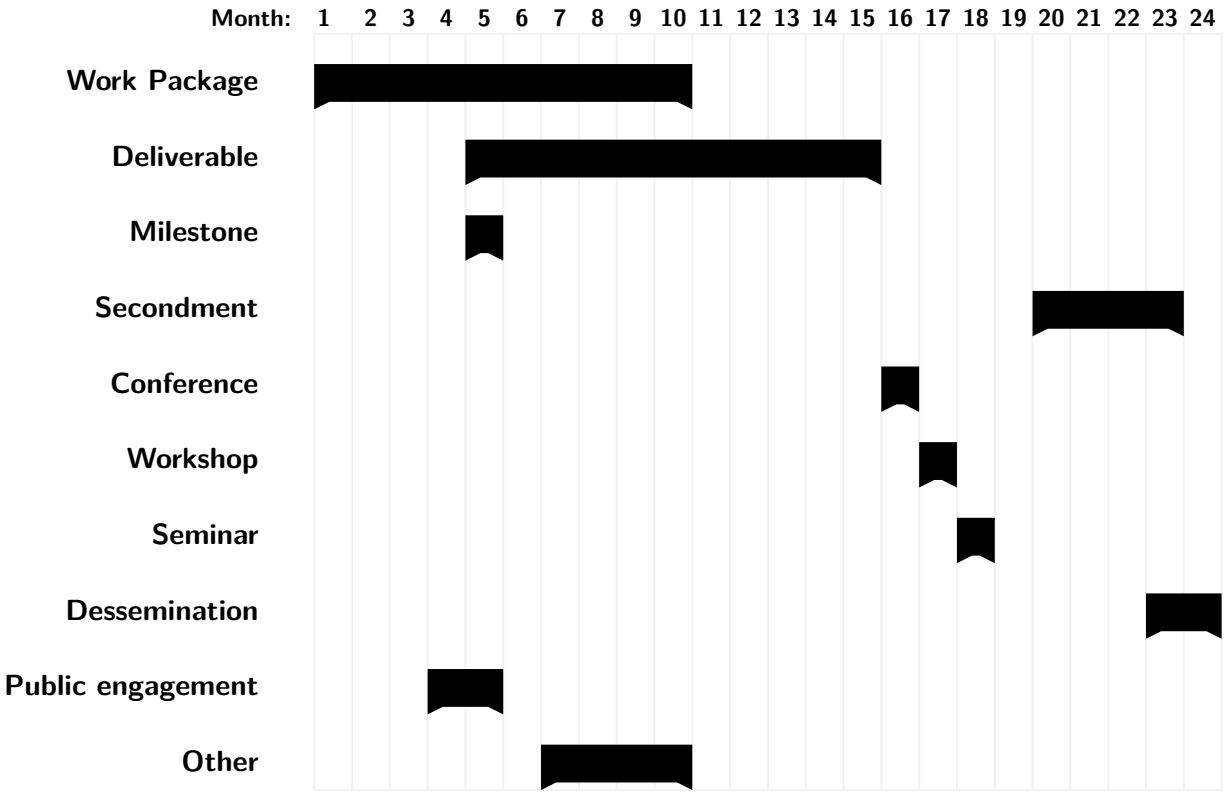

Figure 1: Example Gantt Chart

tution

4.3 Appropriateness of the institutional environment (infrastructure)

Give a description of the legal entity/ies and its main tasks (per participant). Explain why the fellowship has the maximum chance of a successful outcome.

NB: Each participant is described in Section 6. This specific information should not be repeated here.

tences

4.4 Competences, experience and complementarity of the participating organisations and institutional commitment

Here describe how the fellowship will be beneficial for both the Experienced Researcher and host organisation(s).

- Commitment of beneficiary and partner organisations to the programme (for partner organisations, please see also section 6)

Partner organisations: The role of Partner organisations in MS/AC for secondments and their active contribution to the research and training activities should be described.

sec:cv

5 CV OF THE EXPERIENCED RESEARCHER

This section should be limited to maximum 5 pages and should include the standard academic and research record. Any research career gaps and/or unconventional paths should be clearly explained so that this can be fairly assessed by the independent evaluators. The Experienced Researchers must provide a list of achievements reflecting their track, and this may include, if applicable:

1. Publications in major international peer-reviewed multi-disciplinary scientific journals and/or in the leading international peer-reviewed journals, peer-reviewed conference proceedings and/or monographs of their respective research fields, indicating also the number of citations (excluding self-citations) they have attracted.
2. Granted patent(s).
3. Research monographs, chapters in collective volumes and any translations thereof.
4. Invited presentations to peer-reviewed, internationally established conferences and/or international advanced schools.
5. Research expeditions that the Experienced Researcher has led.
6. Organisation of International conferences in the field of the applicant (membership in the steering and/or programme committee).
7. Examples of leadership in industrial innovation.
8. Prizes and Awards.

cities

6 CAPACITIES OF THE PARTICIPATING ORGANISATIONS

All organisations (whether beneficiary or partner organisation) must complete the appropriate table below. Complete one table of maximum one page for the beneficiary and half a page per partner organisation (min font size: 9). The experts will be instructed to disregard content above this limit.

Beneficiary X	
General Description	
Role and Commitment of key persons (supervisor)	(Including names, title, qualifications of the supervisor)
Key Research Facilities, Infrastructure and Equipment	(Demonstrate that the team has sufficient facilities and infrastructure to host and/or offer a suitable environment for training and transfer of knowledge to recruited Experienced Researcher)
Independent research premises?	
Previous Involvement in Research and Training Programmes	
Current involvement in Research and Training Programmes	(Detail the EU and/or national research and training actions in which the partner is currently participating)
Relevant Publications and/or research/innovation products	(Max 5)

Partner Organisation Y	
General Description	
Key Persons and Expertise (supervisor)	
Key Research facilities, infrastructure and equipment	
Previous and Current Involvement in Research and Training Programmes	
Relevant Publications and/or research/innovation product	(Max 3)

ENDPAGE

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