Francisco Maria Calisto

Curriculum Vitae

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Education

PhD Degree in Computer Science and Engineering, *Instituto Superior Técnico*, Universidade de Lisboa, Portugal.

MSc Degree in Information Systems and Computer Engineering, *Instituto Superior Técnico*, Universidade de Lisboa, Portugal.

BSc Degree in Computer Science and Engineering, *Instituto Superior Técnico*, Universidade de Lisboa, Portugal.

Doctoral Thesis

Title *Medical Imaging Diagnosis Assistant*

Supervisors Prof. Jacinto Nascimento, Prof. Nuno Nunes

Description The official starting date of my PhD program in Computer Science and Engineering was September of 2018 and since January of 2020 that my work has been funded by Fundação para a Ciência e a Tecnologia (FCT) with the grant PD/BD/150629/2020 reference. In this thesis, the aim is to develop a new assistant, *i.e.*, a system that will provide diagnosis support as a second opinion. Applying Artificial Intelligent (AI) methods in a real-world scenario are presented, where radiologists and other clinicians can interact with the assistant. Specifically, the goal of this thesis is to study, design and development, as well as evaluation of novel AI-based visual representations supported by intelligent agents for medical imaging diagnosis.

Master Thesis

Title *Medical Imaging Multimodality Breast Cancer Diagnosis User Interface*

Supervisors Prof. Jacinto Nascimento, Prof. Daniel Gonçalves

Description This thesis deals with the use of a recently proposed technique in literature: Deep Convolutional Neural Networks (DCNNs). These deep networks will incorporate information from several different modes: magnetic resonance imaging volumes (MRI), ultrasound images, mammographic images (both views CC and MLO) and text. The Master Thesis primary goal is the development of the user interface for diagnosis of breast cancer in medical imaging multimodality that enable an improved breast cancer diagnosis system based. The second goal is to develop a system to produce a dataset from those user interface annotations and diagnosis classification to be consumed by the Deep Convolutional Neural Networks (DCNNs).

Academic Experience

January 2020 – February 2024 **Doctoral Researcher**, ISR-Lisboa, Lisbon, Portugal.
Working as doctoral researcher under the NetSys program. The program was created through the partnership between Instituto Superior Técnico (IST) and Carnegie Mellon University (CMU). The purpose was to develop and design an intelligent agent as a second reader in order to provide clinicians, as well as the AI community, a sharing and collaborative solution for medical imaging. This solution is giving the potential to classify, segment and explain features, like contours, intersections, margins, shapes and severities that can be used in the process of lesion classification and segmentation in breast cancer diagnosis.

August 2022 – January 2023 **Visiting Scholar**, CMU, Pittsburgh, Pennsylvania, USA.
Working as visiting scholar at the Human-Computer Interaction Institute (HCII), Carnegie Mellon University (CMU) in Pittsburgh, Pennsylvania, USA. The work was supervised by Prof. John Zimmerman, an Associate Professor with a joint appointment between the School of Design and the HCII at CMU. The purpose of this visiting program was to investigate how to blend human and machine intelligence for better decision-making. Specifically, we were interested in understanding how clinicians can more easily grasp machine learning as a decision-making tool. The work includes the development of a decision support system that aids clinicians in breast cancer diagnosis.

November 2018 – December 2019 **Research Fellow**, ITI, Lisbon, Portugal.
Working within a research fellowship for the Interactive Technologies Institute (ITI), with focus on the design and development of systems for healthcare. Researching and developing novel AI-Assistive systems and techniques to support automation, and respectively explainability, in several areas. The plan was to apply an user-centered design approach within a context of Human-Computer Interaction (HCI) for the qualitative and quantitative user research to understand how workflow spaces can use AI-Assistive systems and techniques to create effective and impactful intelligent systems. Under a CMU Portugal program and working for the FeedBot project, the project was funded by FCT with the CMU/ECE/0005/2017 reference from ITI. The institute is a co-founder of the associate Laboratory for Robotics and Engineering Systems (LARSyS), which allows for the exploitation of synergies.

May 2016 – October 2018 **Research Engineer**, ISR-Lisboa, Lisbon, Portugal.
Working as research engineer at the Signal and Image Processing Group (SIPG), a research group from ISR-Lisboa. The inside project was related to HCI and Robotics fields of research, as well as, Health Information Systems, where this project proposes the development of a methodology for detection and cancer targeting breast using multimodality medical imaging and textual information. The project was funded by FCT with the UID/EEA/50009/2013 reference through the LARSys. ISR-Lisboa is also a co-founder of the associate LARSyS.

May 2016 – December 2017 **Online Editor & Web Developer**, Elsevier, London (Remote), United Kingdom.
Developing, analyzing and advertising, as well as content dissemination strategies using the web and social networks as a tool for the Computers & Graphics Journal of Elsevier. The journal is dedicated to disseminate information on research and applications of Computer Graphics (CG) techniques.

November 2015 – December 2017 **Research Assistant**, INESC-ID, Lisbon, Portugal.
Working as research assistant into a research collaborator program to the Visualization and Intelligent Multimodal Interfaces (VIMMI) group at INESC-ID. The VIMMI group aims at researching novel user interaction paradigms and high-performance graphics rendering with applications to health, design and manufacturing areas. My goal was to develop and assist researchers of the VIMMI group with the development of required tools for research purposes, such as tools to extract and analyze publications.

July 2015 – October 2015
Summer Intern, INESC-ID, Lisbon, Portugal.
From July 2015 to October 2015, I was working as summer intern for both research groups at INESC-ID, namely Visualization and Intelligent Multimodal Interfaces (VIMMI) and Information and Decision Support Systems (IDSS) groups. For the first research group, I was developing and creating the new VIMMI platform, providing information about research projects of the VIMMI group. Regarding this first research group, the task was held from July 2015 to October 2015. The second task of the IDSS group was only held from July 2015 to September 2015. For this second task, I was working as User Interface Developer for the IDSS group. Specifically, the goal was developing and creating a DELPHI method through the software interface as a survey platform for research purposes of the IDSS group.

Teaching Experience

May 2023 – Present
Invited Assistant Professor, Instituto Superior Técnico (IST), Lisbon, Portugal.
Working as Invited Assistant Professor on the User-Centered Design and Evaluation (UCD) unit from the Master Degree of Computer Science and Engineering (MEIC). This unit introduces the main methods and techniques of user-centered research and evaluation. Through an open-ended practical group project, students are exposed to problems of increasing complexity in which they can practice the methods and techniques described. The learning objectives are as follows: i) collect and analyze information about the different participants in a system; ii) choose research techniques to design and develop interactive systems and services; (iii) trackable synthesize research findings into innovative concepts and ideas; iv) work as a team managing various perspectives and talents; v) communicate and negotiate with different participants the design and alternatives for the different solutions.

February 2019 – July 2019
Teaching Assistant, Instituto Superior Técnico (IST), Lisbon, Portugal.
Working as Teaching Assistant on the HCI unit from Bachelor Degree of Computer Science and Engineering (LEIC). This unit intends to give students knowledge regarding how to understand the principles and basic rules required to design and develop usable user interfaces. Identify the users and the tasks they want to carry out with the interactive system we plan to develop. Be able to evaluate interfaces at different stages of their development, applying the most correct evaluation technique. Identify the critical factors in the design of user interfaces. Understand and apply trade-offs between the different restrictions affecting the design of interfaces. Learn to frame the design of interfaces within the scope of computer science engineering projects.

September 2016 – February 2019
Supporting Lecturer, Instituto Superior Técnico, Lisbon, Portugal.
Working as Supporting Lecturer on the Usability and Information Systems (USI) unit from Master Degree of Information and Enterprise Systems (MISE). For this unit, I lecture for the September 2016 – February 2017 and September 2018 – February 2019 semestres. This unit intends to give students knowledge about the basic principles and rules for designing and developing user interfaces.

Supervising Students

Definition:
Students officially supervised by me (post-Doctorally) after the conclusion of my Doctoral Program and receipt of my Ph.D. certificate, with or without official co-supervision of other formal faculties.

January 2022 – February 2024
Vicente Sobral, *Master Student*, Instituto Superior Técnico, ULisboa.
In this Master Thesis, the author proposes to design an intelligent agent that provides AI outputs for breast cancer diagnosis along with uncertainty estimates. For that, several outputs from our already developed AI models will show the results to clinicians in real-world clinical scenarios. The ambiguity-aware AI assistant will highlight the cases likely to be less trivial while presenting arguments for conflicting classification choices. The AI assistant will reduce the clinician's burden during diagnosis with this work. The AI assistant will provide the most controversial cases to diagnose at the beginning of the clinician's shift, and less controversial cases at the end.

January 2022 – October 2024
Miguel Bastos, *Master Student*, Instituto Superior Técnico, ULisboa.
In this Master Thesis, the author proposes the design and development of a web-based system for semantic and lexical annotation of medical images integrated into a medical imaging visualization framework for breast cancer diagnosis. The goal is to feed the generated data to Machine Learning algorithms to help clinicians diagnose and decide. This work will be integrated into a real-world clinical project.

Advising Students

Definition: Students informally advised by me (pre-Doctorally) before the conclusion of my Doctoral Program and receipt of my Ph.D. certificate, with official co-supervision of other formal faculties.

June 2021 – October 2022
João Fernandes, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was advised by me during his Master Thesis work, titled as "Towards Assertiveness-based Interactive Agents with Different Behaviours for Breast Cancer Diagnosis" and successfully defended with 17/20 marks. In this Master Thesis, the author proposes developing and studying a prototype that seeks to understand how the level of assertiveness, displayed by an AI agent, will impact the clinicians' decision-making process during the breast cancer diagnosis. The goal is to develop a proof-of-concept prototype, a medical imaging assistant, following the respective scenarios of the assistant functionalities that most fit the clinical workflow.

September 2019 – January 2021
Hugo Lencastre, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during his Master Thesis work, titled as "Breast Cancer Multimodality Scalable Interactions" and successfully defended with 16/20 marks. In this Master Thesis, the author proposes designing novel interactive techniques in a platform that enhances the annotation process of medical images, in the breast cancer domain. The author will do that by taking several interaction techniques to improve the engagement and production of qualified datasets, fostering their sharing and practical evaluation among physicians.

September 2019 – January 2021
Nádia Mourão, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during her Master Thesis work, titled as "2D Breast Cancer Diagnosis Explainable Visualizations" and successfully defended with 16/20 marks. In this Master Thesis, the author seeks to strengthen empirical clinical applications of XAI by exploring the underpinnings of medical decision-making, drawing from medical imaging. To facilitate physician's understanding of AI, the author proposes developing a novel XAI framework for clinical purposes. With the introduction of an XAI technique into an AI system, physicians can explore the output (e.g., image segmentation) and better understand the AI results, diminishing the perception of them as being 'black-boxes'.

Mentoring Students

Definition: Students mentored only technically by me and officially supervised by other faculties.

August 2023 – December 2023 **Jonah Sklar**, *Master Student*, HCII, CMU.
Mentored Jonah Sklar during his Independent Study at the Human-Computer Interaction Institute (HCII) at Carnegie Mellon University (CMU). The study, titled "Towards Ambiguity-aware AI Assistants for Breast Cancer Diagnosis at UPMC," aimed to design an AI assistant capable of managing ambiguous cases in breast cancer diagnosis, thereby aiding in effective workload management for clinicians. Jonah's involvement was pivotal in the initial phase of the project, conducting extensive planning for the stakeholder interviews to understand clinician needs and challenges in breast cancer diagnosis. Jonah's contributions were instrumental in laying the groundwork for the AI assistant's conceptual design, tailored to the specific needs of clinicians at UPMC.

August 2023 – December 2023 **Laura Wei**, *Master Student*, HCII, CMU.
Guided Laura Wei in her Independent Study at the Human-Computer Interaction Institute (HCII) of Carnegie Mellon University (CMU). The project, named "Towards Ambiguity-aware AI Assistants for Breast Cancer Diagnosis at UPMC," was centered on creating an AI assistant designed to assist in diagnosing breast cancer. Laura Wei's pivotal role in the project involved developing a recruitment screener to select diverse participants, including radiologists and ML technicians. She formulated questions to capture varied demographics and AI expertise, ensuring diverse perspectives in the study. Her skills in research design and commitment to diversity significantly influenced the early stages of the project, particularly in participant recruitment and data collection, laying a strong foundation for the study's success.

August 2023 – December 2023 **Zaynab At-Taras**, *Master Student*, HCII, CMU.
I mentored Zaynab At-Taras during her Independent Study work at the Human-Computer Interaction Institute (HCII) at Carnegie Mellon University (CMU). The study, titled "Towards Ambiguity-aware AI Assistants for Breast Cancer Diagnosis at UPMC," focused on creating an AI assistant to facilitate breast cancer diagnosis. Zaynab played a pivotal role in this project, adeptly coordinating with field experts and seamlessly integrating their insights into the AI model's development. Her proficiency in research methodologies and her ability to foster effective collaborations were key factors in propelling the project forward. Zaynab's contributions were crucial, especially in forging essential connections and providing insights that significantly influenced the research's trajectory.

June 2021 – November 2022 **Pedro Diogo**, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during his Master Thesis work, titled as "Diagnosis and Detection of Breast Cancer using Deep Multiple Instance Learning" and successfully defended with 19/20 marks. In this Master Thesis, the author proposes an autonomous system that takes advantage of deep convolutional features for image analysis and the Multiple Instance Learning framework for labeling a set of slices within volumes and/or a set of patches within slices. The ultimate goal is to achieve classification based on the whole MRI and based on the slices, where the former will permit to assess the slices that triggered the classification, and the latter will make possible the visual explanation of the proposed diagnosis through the localization of the lesion in the image.

January 2021 – June 2022 **Margarida Morais**, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during her Master Thesis work, titled as "Mimicking the Radiologists workflow in MRI Breast Classification" and successfully defended with 19/20 marks. In this Master Thesis, the author proposes the use of a 3D Convolutional Neural Network (CNN) architecture to perform the classification of Breast Cancer (BC) lesions using Magnetic Resonance Imaging (MRI) scans. An MRI scan is composed by different sequences, where each one provides different information from the tissues under examination. When inspecting these exams in order to conclude a diagnosis, radiologists have a "cycling" workflow where they examine different MRI volumes for the purpose of having more accurate assessments. The 3D model is trained using different volumes in a uni-modal strategy, which will allow to compare the individual performance of each volume and conclude if there is a preponderant one. Furthermore, a late-fusion strategy is used to mimic the workflow of the radiologists by considering the classifications of different volumes for the final result. Lastly, the curation process of a new BC medical imaging dataset is discussed.

July 2020 – December 2021 **Madalena Pedreira**, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during her Master Thesis work, titled as "Multimodal HyperDense-Net Classification For Breast Diagnosis" and successfully defended with 16/20 marks. In this Master Thesis, the author proposes an advanced DL solution through a Multimodal architecture for classification of mammography screenings utilizing an Hyperdense Network with a weak-label approach. Following the importance of early detection in breast cancer to decrease today's alarming mortality rates, traditional and innovative approaches on breast cancer diagnosis are compared. In the wake of the emerging research on Computer-Aided Detection (CAD) practices with Deep Learning (DL) approaches in the mammography screening field and given DL model's current successes in this context, an approach on the modern practices to overcome the particular challenges of data insufficiency, information loss and lack of computational power are also featured. Finnaly, the curation process of an unestablished private unbalanced dataset is discussed.

July 2020 – December 2021 **João Bernardo**, *Master Student*, Instituto Superior Técnico, ULisboa.
The Master Student was mentored by me during his Master Thesis work, titled as "Explaining Classification in Breast Images Using Visual Activation Maps" and successfully defended with 15/20 marks. In this Master Thesis, the architecture of deep Convolutional Neural Networks (CNNs) is thoroughly reviewed. An end-to-end model is proposed to achieve multi-class classification of the mammogram, trained with image-level annotations. Class Activation Mapping (CAM) is proposed to enable the previous model to obtain visual explanations of the proposed diagnosis, achieving image segmentation. Moreover, this work proposes a pipeline for converting a collection of mammograms into an usable screening mammography dataset for training and evaluating the proposed models. Using a DenseNet-121 model, the fully-automated classification of mammograms as either (Normal, Benign, Malignant) shows promising results, achieving a 3-Class Mean AUC of (0.81). Additionally, segmentation was successful at providing insight into such a model.

Committee Member

Group 2025
UbiComp/ISWC 2023 Posters and Demos

Reviewer Experience

Conferences **Reviewer**, TMLR 2023, AMCIS 2023 Papers, IMX 2023 Technical Papers, CogSci 2023 Full Papers, INTERACT 2023 Full Papers, ICWSM 2023 Full Papers, HRI 2023 Main Track, HRI 2023 Pioneers, HRI 2023 Student Design Competition, CHI 2023 Case Studies, CHI 2023 Papers, CHI 2023 alt.chi, CHI 2023 Late-Breaking Work (**Special Recognitions for Outstanding Reviews**), CUI 2023 Papers (**Special Recognitions for Outstanding Reviews**), CSCW 2023 Full Papers, TMLR 2023, ISS 2022 Papers (**Special Recognitions for Outstanding Reviews**), DIS 2022 Papers and Pictorials, C&C 2022 Pictorials, CogSci 2022 Papers, ETRA 2022 Short Papers, EICS PACM 2022 Full Papers, IMX 2022 Technical Papers, CHI 2022 Late-Breaking Works, CHI 2022 Full Papers, CHI 2022 Case Studies, ECIS 2022 Papers, HRI 2022 Late-Breaking Reports, DIS 2021 Papers and Pictorials, INTERACT 2021 Full Papers, IEEE VR 2021 WEVR Workshop: Everyday Virtual Reality, IEEE VR 2021 Workshop: Distributed Interactive Systems for Collab Experiences, IEEE VR 2021 Workshop: Novel Input Devices and Interaction Techniques, IEEE VR 2021 Videos, ICMI 2020 Demonstrations, ICWSM 2021 Full Papers, AVI 2020 Full Papers, AVI 2020 Short Papers, DIS 2020 Papers (**Special Recognitions for Outstanding Reviews**), CogSci 2020 Full Papers, ETRA 2020 Full Papers, CHI 2020 Late-Breaking Works, CHI 2020 alt.chi, ECIS 2020, Full Papers, HRI 2020 alt.HRI.

Journals **Reviewer**, IEEE Access, Neural Networks, International Journal of Human-Computer Studies, Intelligent Systems with Applications, JMLR 2023, Annals of Operations Research, Scientific Reports, JMIR, Intelligent Medicine, Expert Systems with Applications, EICS PACM 2022, IJTKS, IEEE VR 2020 Journal Papers, EICS PACM Q2 2018.

Books **Reviewer**, Human-Centric Computing and Information Sciences Book on Digital Anatomy for CHAP-2.1-R3, CHAP-2.3-R2, CHAP-2.4-R1.

Talks

April 2023 **ITI Talks**, Interactive Technologies Institute, *Hub Criativo do Beato, Lisbon*, Portugal, "Assertiveness-based Agent Communication for a Personalized Medicine on Medical Imaging Diagnosis".

The Lab2Market@Técnico program aims to support the commercialization of technology developed by PhD students, Master students and faculty members of Instituto Superior Técnico (IST) by providing specialized business consultancy, with the support of NTT Data/i-Deals Portugal. The program is providing selected research teams with 250 hours of consultancy time to help them assess market potential, develop value propositions, and prepare for presentations to investors and potential partners/clients. For this talk, I was invited to present at the 2023 edition of the program to share the achievements of my participation during the 2022 edition of the program. Our project, named BreastScreening-AI, aimed to reduce the number of unnecessary biopsies for the diagnosis of breast cancer by using AI to aid in diagnosis and mitigate clinical errors across several medical imaging modalities. The project was developed in partnership with an IST professor and in collaboration with the Institute for Systems and Robotics (ISR), an associate laboratory of IST.

January 2023 **Lab2Market Program Launching Session**, Instituto Superior Técnico, *Lisbon*, Portugal, "BreastScreening-AI".

The Lab2Market@Técnico program aims to support the commercialization of technology developed by PhD students, Master students and faculty members of Instituto Superior Técnico (IST) by providing specialized business consultancy, with the support of NTT Data/i-Deals Portugal. The program is providing selected research teams with 250 hours of consultancy time to help them assess market potential, develop value propositions, and prepare for presentations to investors and potential partners/clients. For this talk, I was invited to present at the 2023 edition of the program to share the achievements of my participation during the 2022 edition of the program. Our project, named BreastScreening-AI, aimed to reduce the number of unnecessary biopsies for the diagnosis of breast cancer by using AI to aid in diagnosis and mitigate clinical errors across several medical imaging modalities. The project was developed in partnership with an IST professor and in collaboration with the Institute for Systems and Robotics (ISR), an associate laboratory of IST.

December 2022 **OutSystems AI Reading Group**, Boston, Massachusetts, USA, "Personalizing and Customizing AI Explanations for Clinicians".

Invited to present the work under development by Institute for Systems and Robotics (ISR-Lisboa) and Interactive Technologies Institute (ITI), the one hour presentation and discussion were held in the 16th of December, 2022. The work was presented remotely to the AI Reading Group at OutSystems in Boston, Massachusetts. For this talk, I was invited to present our team, project, and work to the research team of Dr. Alexandre Lemos, a Senior Research Scientist of OutSystems. In the end, the presentation proposes and discusses how personalizing and customizing the answers coming from the AI outputs can positively affect the clinical workflow. Moreover, we present how those strategies are promoting the unbiased behavior of clinicians while improving the clinical workflow.

October 2022 **Stanford University Neuroradiology Talks**, Stanford, California, USA, "Personalizing and Customizing AI Explanations for Clinicians".

Invited to present the work under development by Institute for Systems and Robotics (ISR-Lisboa) and Interactive Technologies Institute (ITI), the one hour presentation and discussion were held in the 27th of October, 2022. The work was presented remotely to the Department of Rad/Neuroimaging and Neurointervention at Stanford University in California. For this talk, I was invited to present our team, project, and work to the research team of Prof. Greg Zaharchuk. In the end, the presentation proposes and discusses how personalizing and customizing the answers coming from the AI outputs can positively affect the clinical workflow. Moreover, we present how those strategies are promoting the unbiased behavior of clinicians while improving the clinical workflow.

September 2022 **UPMC Magee-Womens Hospital Talk**, Pittsburgh, Pennsylvania, USA, "AI-based Solutions for Diagnosing Breast Cancer".

Invited to present the work under development by Institute for Systems and Robotics (ISR-Lisboa) and Interactive Technologies Institute (ITI), the two hours presentation was held in the 27th of September, 2022. The work was presented to the Imaging Research Laboratory of the Department of Radiology at UPMC Magee-Womens Hospital in Pittsburgh. For this talk, I was invited to present our project and AI-based solutions to the research team of Prof. Robert Nishikawa and Prof. Juhun Lee from the Imaging Research Laboratory. In the end, the presentation proposes and discuss several strategies that we have in AI solutions, in which those strategies are promoting unbiased behavior of clinicians while improving the clinical workflow.

January 2022 **LaSEEB Seminars**, Instituto Superior Técnico, Portugal, "Impact of Assertiveness-based Interactions in Medical Imaging Diagnosis".

Presenting as invited speaker, the BreastScreening-AI work under development for the Evolutionary Systems and Biomedical Engineering Lab (LaSEEB) at ISR-Lisboa. LaSEEB is dedicated to research in biomedical systems and engineering, along two main lines: Biomedical Engineering and Bio-Inspired Algorithms. The approaches employed by the group involve biological and biomedical imaging, ranging from cell microscopy to ultrasound and magnetic resonance imaging, as well as physiological signals such as the electroencephalogram and the electrocardiogram. For this talk, I was invited to present our work-in-progress concerning how the levels of assertiveness, displayed by an intelligent agent, will impact radiologists' decision-making process during the breast cancer diagnosis. In the end, the presentation proposes and discuss several strategies, expecting to promote unbiased behavior of clinicians while improving the clinical workflow.

December 2021 **ITI Talks**, Instituto Superior Técnico, Portugal, "Impact of Assertiveness-based Interactions in Medical Imaging Diagnosis".

Presenting as invited speaker, the BreastScreening-AI work at the Interactive Technologies Institute (ITI) laboratory. ITI is dedicated to the interdisciplinary field of HCI and encloses Psychology and Social Sciences, Computer Science, and Creativity and Design as core scientific areas. For this talk, I was invited to present the work-in-progress concerning how the levels of assertiveness, displayed by an intelligent agent, will impact radiologists' decision-making process during the breast cancer diagnosis. In the end, the presentation proposes and discuss several strategies, expecting to promote unbiased behavior of clinicians while improving the clinical workflow.

November 2021 **StartHealth@Ulisboa**, University of Lisbon, Portugal, BreastScreening-AI.

Presenting as participant, the BreastScreening-AI work for the third edition of StartHealth@Ulisboa pitch competition. This competition calls for the submission of proposals by teams of researchers interested in testing and validating the business potential of their ideas and results of R&D in the fields of healthcare.

October 2020 **PhD Open Days 2020**, Instituto Superior Técnico, Portugal, "Medical Imaging Multimodality Annotating Framework".

Presenting as participant, the BreastScreening-AI work for the sixth edition of PhD Open Days 2020 poster sessions and pitch competition. The traditional pitch competition and the "Out of the box" debate are sessions in which the goal is to stimulate a culture of innovation and entrepreneurship among the PhD students of IST. For these poster sessions and pitch competition, I was presenting a new medical imaging framework with an interactive UI to generate a standardized dataset of medical imaging annotations.

June 2018 **LARSyS Annual Meeting 2018**, Pavilhão do Conhecimento, Lisbon, Portugal, BreastScreening: A Multimodality Diagnostic Assistant.

In this talk, we present an assistant for a fully automated breast cancer detection and segmentation from multimodal medical images. This assistant was crucial for developing new machine learning methodologies(*e.g.*, Deep Convolutional Neural Networks) that will be able to provide a reliable automatic classification of the whole exam, based on the data above mentioned.

Training Activity

March 2021 **Neural Networks and Deep Learning**, Coursera, Online, DeepLearning.AI.
The Deep Learning Specialization is our foundational program that will help you understand the capabilities, challenges, and consequences of deep learning and prepare you to participate in the development of leading-edge AI technology. It provided a pathway for me to gain the knowledge and skills to apply machine learning to my research work, and take the definitive step in the world of AI.

February 2021 **Machine Learning**, Coursera, Online, Stanford University.
In this class, I have learn about the most effective machine learning techniques, and gain practice implementing them and getting them to work for my research projects. More importantly, I have learn about not only the theoretical underpinnings of learning, but also gain the practical know-how needed to quickly and powerfully apply these techniques to new problems. Finally, you have learn about some of Silicon Valley's best practices in innovation as it pertains to machine learning and AI.

February 2017 – May 2017 **How to Build a Startup**, Udacity, Online, The Lean LaunchPad.
In this course, I learned what it takes to build a successful startup using the Customer Development process, where entrepreneurs "get out of the building" to gather and iterate on feedback. The main idea in this course was learning how to rapidly develop and test ideas by gathering massive amounts of customer and marketplace feedback. Many startups fail by not validating their ideas early on with real-life customers. In order to mitigate that, I learned with this course how to get out of the building and search for the real pain points and unmet needs of customers.

February 2017 **React-Native: The Mobile Paradigm Native vs Hybrid**, SINFO 2017, Lisbon, Portugal.
A workshop on the React Native framework. React Native let us build mobile apps using only JavaScript. It uses the same design as React, letting you compose a rich mobile UI from declarative components. The course gave me a comprehensive understanding of the framework and its capabilities, including the ability to build mobile apps using only JavaScript. The course also explored the similarities in design between React and React Native, allowing me for the creation of a rich mobile user interface using declarative components. The course covered both theoretical concepts and hands-on practice, gaving me a solid foundation in the framework for building efficient and high-performing mobile applications.

July 2016 – August 2016 **Learn React.js: The Basics**, Lynda, Online, JavaScript.
The course wraps with a chapter dedicated to building a more complete app with React.js and companion tools like Babel, NPM, and more. This course gave me an in-depth look at the core features and functions of the React.js library, including JSX, component lifecycle methods, and state management. It also covered advanced topics such as building reusable components, using tools like Babel and NPM, and building a more complete app with the React.js library. It gave me hands-on experience and practical examples to help applying my knowledge and skills to real-world projects.

March 2016 – May 2016 **Mastering GitHub**, Code School, Online, Git.
Learn advanced tips, tricks, and proven best practices for collaborating more effectively with GitHub. The course covers various tips, tricks, and best practices for maximizing the use of the GitHub platform for teamwork and collaboration. It is designed to help individuals become proficient in utilizing the platform to streamline communication, increase efficiency, and improve the overall workflow. The course is ideal for anyone looking to enhance their teamwork skills and advance their understanding of GitHub.

Articles

April 2023 **Assertiveness-based Agent Communication for a Personalized Medicine on Medical Imaging Diagnosis**, ACM CHI 2023, Hamburg, Germany.

In this paper, we designed two approaches to communicate the decisions of an intelligent agent for breast cancer diagnosis with different tones: a suggestive (non-assertive) tone and an imposing (assertive) one. We used an intelligent agent to inform about: (1) number of detected findings; (2) cancer severity on each breast and per medical imaging modality; (3) visual scale representing severity estimates; (4) the sensitivity and specificity of the agent; and (5) clinical arguments of the patient, such as pathological co-variables. Our results demonstrate that assertiveness plays an important role in how this communication is perceived and its benefits. We show that personalizing assertiveness according to the professional experience of each clinician can reduce medical errors and increase satisfaction, bringing a novel perspective to the design of adaptive communication between intelligent agents and clinicians.

December 2022 **Modeling Adoption of Intelligent Agents in Medical Imaging**, International Journal of Human-Computer Studies, Volume 168, Elsevier.

In this research, we propose a model based on the unified theory of acceptance and use of technology to study the determinants for the adoption of intelligent agents across the medical imaging workflow. We tested the model via confirmatory factor analysis and structural equation modeling using clinicians' data from an international evaluation of healthcare practitioners. Results show an increased understanding of the vital role of security, risk, and trust in the usage intention of intelligent agents. These empirical findings provide valuable theoretical contributions to researchers by explaining the reasons behind the adoption and usage of intelligent agents in the medical imaging workflow.

May 2022 **BreastScreening-AI: Evaluating medical intelligent agents for human-AI interactions**, Artificial Intelligence in Medicine, Volume 127, Elsevier.

In this paper, we developed BreastScreening-AI within two scenarios for the classification of multimodal beast images: (1) Clinician-Only; and (2) Clinician-AI. The novelty relies on the introduction of a deep learning method into a real clinical workflow for medical imaging diagnosis. We attempt to address three high-level goals in the two above scenarios. Concretely, how clinicians: i) accept and interact with these systems, revealing whether are explanations and functionalities required; ii) are receptive to the introduction of AI-assisted systems, by providing benefits from mitigating the clinical error; and iii) are affected by the AI assistance. We conduct an extensive evaluation embracing the following experimental stages: (a) patient selection with different severities, (b) qualitative and quantitative analysis for the chosen patients under the two different scenarios. We address the high-level goals through a real-world case study of 45 clinicians from nine institutions. We compare the diagnostic and observe the superiority of the Clinician-AI scenario, as we obtained a decrease of 27% for False-Positives and 4% for False-Negatives. Through an extensive experimental study, we conclude that the proposed design techniques positively impact the expectations and perceptive satisfaction of 91% clinicians, while decreasing the time-to-diagnose by 3 min per patient.

June 2021 **Introduction of Human-Centric AI Assistant to Aid Radiologists for Multimodal Breast Image Classification**, International Journal of Human-Computer Studies, Volume 150, Elsevier.

In this research, we take an HCI perspective on the opportunities provided by AI techniques in medical imaging, focusing on workflow efficiency and quality, preventing errors and variability of diagnosis in Breast Cancer. Starting from a holistic understanding of the clinical context, we developed BreastScreening to support Multimodality and integrate AI techniques (using a deep neural network to support automatic and reliable classification) in the medical diagnosis workflow. This was assessed by using a significant number of clinical settings and radiologists. Here we present: i) user study findings of 45 physicians comprising nine clinical institutions; ii) list of design recommendations for visualization to support breast screening radiomics; iii) evaluation results of a proof-of-concept BreastScreening prototype for two conditions Current (without AI assistant) and AI-Assisted; and iv) evidence from the impact of a Multimodality and AI-Assisted strategy in diagnosing and severity classification of lesions. The above strategies will allow us to conclude about the behaviour of clinicians when an AI module is present in a diagnostic system. This behaviour will have a direct impact in the clinicians workflow that is thoroughly addressed herein. Our results show a high level of acceptance of AI techniques from radiologists and point to a significant reduction of cognitive workload and improvement in diagnosis execution.

September 2020 **BreastScreening: On the Use of Multi-Modality in Medical Imaging Diagnosis**, ACM AVI 2020, Salerno, Italy.

This paper describes the field research, design and comparative deployment of a multimodal medical imaging user interface for breast screening. The main contributions described here are threefold: 1) The design of an advanced visual interface for multimodal diagnosis of breast cancer (BreastScreening); 2) Insights from the field comparison of Single-Modality vs Multi-Modality screening of breast cancer diagnosis with 31 clinicians and 566 images; and 3) The visualization of the two main types of breast lesions in the following image modalities: (i) MammoGraphy (MG) in both Craniocaudal (CC) and Mediolateral oblique (MLO) views; (ii) UltraSound (US); and (iii) Magnetic Resonance Imaging (MRI). We summarize our work with recommendations from the radiologists for guiding the future design of medical imaging interfaces.

October 2017 **Towards Touch-Based Medical Image Diagnosis Annotation**, ACM ISS 2017, Brighton, UK.

This article aims to present a performance and experience analysis conducting a study of touch and traditional environments. As a Conference Poster (in Proceedings of the 2017 ACM International Conference) format and Extended Abstract at the ACM ISS 2017. Taking place from October 17 to 20 in Brighton, UK, the ACM ISS 2017 is the premier venue for research addressing the design, development and use of new and emerging tabletop, digital surface, interactive spaces and multi-surface technologies.

Posters

March 2023 **External Validation of a Deep Learning Model for Breast Density Classification**, ECR 2023, Vienna, Austria.

Breast density refers to the relative amount of epithelial and stromal tissue elements (radiopaque) compared with the amount of fatty elements (radiolucent) seen in mammography and the Breast Imaging Reporting and Data System (BI-RADS) lexicon has classified mammographic density into four categories, with the percentage of each tissue density in the general screening population estimated as follows: 10% of women have breasts that are almost entirely fatty, 40% have scattered areas of fibroglandular density, 40% have heterogeneously dense breasts, and 10% have extremely dense breasts.

October 2020 **Medical Imaging Multimodality Annotating Framework**, PhD Open Days 2020, Lisbon, Portugal.

In this poster, we present the development of a framework for providing a User Interface (UI) to annotate and visualize masses and calcifications of breast cancer lesions in a multimodality strategy are disclosed. The multimodality strategy supports the following image modalities: (i) MammoGraphy (MG) in both CranioCaudal (CC) and MedioLateral Oblique (MLO) views; (ii) UltraSound (US); and (iii) Magnetic Resonance Imaging (MRI) volumes. The UI receives a set of medical images to be annotated. In order to annotate the medical images, the UI comprises two lesion tools: (1) a freehand polygon tool for annotating the masses of breast cancer lesions; and (2) a bullet probe on the image for annotating the calcifications of breast cancer lesions. These tools generate a dataset of manual annotations, which will be able to extract features (e.g., lesion contours, intersections, and shapes) that can be used in the lesion segmentation and classification computation made by automatic agents. Such automatic agents can have the integration of algorithms from the Artificial Intelligence (AI), Machine Learning (ML), or Deep Learning (DL) literature.

July 2019 **BreastScreening: Towards Breast Cancer Clinical Decision Support Systems**, National Science Summit'19, Lisbon, Portugal.

In this poster, we utilized the unprecedented opportunity presented by developing Radiomics to investigate how a Clinical Decision Support System (CDSS) could add value in the breast cancer chain, including improvements of the workflow. It was presented on the Ciência 2019. The conference aims at promote a broad debate on the main topics and challenges of the scientific agenda beyond the world of research. The meeting main goal, therefore, is to stimulate not just the participation but also the interaction between researchers, the business sector and the general public.

July 2019 **FeedBot: Understanding Users With Physical Difficulties During Meal**, National Science Summit'19, Lisbon, Portugal.

FeedBot is a robotic arm that can feed a Cerebral Palsy (CP) patient without any type of external help. In this poster, we apply several HCI techniques to understand users Point-of-View (POV) and other measurements during meal. It was presented on the Ciência 2019. The conference aims at promote a broad debate on the main topics and challenges of the scientific agenda beyond the world of research. The meeting main goal, therefore, is to stimulate not just the participation but also the interaction between researchers, the business sector and the general public.

May 2019 **Medical Imaging Diagnosis Assistant: AI-Assisted Radiomics Framework User Validation**, Keep In Touch'19, Instituto Superior Técnico, Lisbon, Portugal.

In this poster, we utilized the unprecedented opportunity presented by developing Radiomics to investigate how a Multi-Modality Framework and AI could add value in the Medical Imaging (MI) chain, including improvements of the workflow. It was presented on the Ciência 2019. The conference aims at promote a broad debate on the main topics and challenges of the scientific agenda beyond the world of research. The meeting main goal, therefore, is to stimulate not just the participation but also the interaction between researchers, the business sector and the general public.

May 2019 **FeedBot: Feeding Users With Motion-Related Disabilities HCI Approach**, Keep In Touch'19, Instituto Superior Técnico, Lisbon, Portugal.

FeedBot is a robotic arm that can feed a Cerebral Palsy (CP) patient without any type of external help. Our work in HCI will be to understand what is needed by both patients and his caregivers, while we want to know how can we achieve their expectations, as well as the user requirements. It was presented on the Ciência 2019. The conference aims at promote a broad debate on the main topics and challenges of the scientific agenda beyond the world of research. The meeting main goal, therefore, is to stimulate not just the participation but also the interaction between researchers, the business sector and the general public.

July 2018 **BreastScreening: A Multimodality Diagnostic Assistant**, National Science Summit'18, Lisbon, Portugal.

This poster aims to present an assistant for a fully automated breast cancer detection and segmentation from multi-modal medical images introducing clinical covariates. It was presented on the Ciência 2018. The conference aims at promote a broad debate on the main topics and challenges of the scientific agenda beyond the world of research. The meeting main goal, therefore, is to stimulate not just the participation but also the interaction between researchers, the business sector and the general public.

June 2018 **BreastScreening: A Multimodality Diagnostic Assistant**, LARSyS 2018 Annual Meeting, Lisbon, Portugal.

This poster aims to present an assistant for a fully automated breast cancer detection and segmentation from multi-modal medical images introducing clinical covariates. It was presented on the LARSyS 2018 Annual Meeting, a two-day event designed to provide an opportunity for LARSyS researchers to engage in interdisciplinary debates about current and future aspects in robotics and systems research with applications in engineering systems with large society implications.

October 2017 **Towards Touch-Based Medical Image Diagnosis Annotation**, ACM ISS 2017, Brighton, UK.

This poster aims to present a performance and experience analysis conducting a study of touch and traditional environments. As a Conference Poster (in Proceedings of the 2017 ACM International Conference) format and Extended Abstract at the ACM ISS 2017. Taking place from October 17 to 20 in Brighton, UK, the ACM ISS 2017 is the premier venue for research addressing the design, development and use of new and emerging tabletop, digital surface, interactive spaces and multi-surface technologies.

Technical Skills

Programming Languages	Python, R, PHP, Java, Lisp, Scheme, Prolog, C++, C, Assembly
Web	JavaScript, HTML, CSS, JSON, XML, WordPress, Apache, Tomcat, WebServices (SOAP), Maven, NPM, Babel, WebPack, Composer
IDE	SublimeText, Eclipse, NetBeans, VisualStudio
Libraries / Frameworks	React, Redux, Router, Laravel, Bootstrap, Foundation
Technologies	MVC, J2EE, Git
Database	MySQL, MongoDB
Modeling	UML, SysUML, BPMN
Methodologies	Agile, Scrum, Lean, Kanban

Operating Systems	Windows, Linux, Unix, Macintosh
Software	Triskell, Bizagi, Microsoft Project, Microsoft Office

Projects

- FeedBot
- BreastScreening
- Medical Imaging Diagnosis Assistant
- Medical Imaging Multimodality Breast Cancer Diagnosis User Interface
- SnapJob (formerly GigZap): Temporary Jobs Application
- Agroop Livestock: Livestock Web Application
- Computers & Graphics Journal Web Dissemination
- VIMMI Platform
- Support System Delphi Studies

Organizations

July 2016 – Membership ongoing

Association for Computing Machinery (ACM), ACM Member, New York, NY, USA.

The ACM and the IEEE Computer Society are the umbrella organizations for US academic and scholarly interests in computing. Unlike the IEEE, the ACM is solely dedicated to computing. Being an ACM member offers many benefits such as lifelong learning programs, access to exclusive publications and discounts on conferences and events. Moreover, it offers the ability to participate in a wide range of activities that keep ACM moving, including organizing conferences, editing journals, reviewing papers and participating on boards and committees. As members, we become a part of the dynamic changes that are transforming our world, by helping to shape the future of computing.

September 2017 – Membership ongoing

ACM SIGCHI, ACM Member, New York, NY, USA.

The ACM Special Interest Group on Computer-Human Interaction is the world's largest association of professionals who work in the research and practice of computer-human interaction. This membership provides access to a wide range of resources and benefits. Joining the ACM SIGCHI community is an excellent way to stay current with the latest developments in the field of HCI and to connect with professionals in the field.

October 2015 – Membership ongoing

Interaction Design Foundation, Member, Aarhus, Denmark.

The Interaction Design Foundation (IxDF) is a non-profit educational organization which produces open content and Open Access educational materials online with the stated goal of "democratizing education by making world-class educational materials free for anyone, anywhere". Its mission is to improve the careers of individuals in the field of design by providing high-quality, accessible education. The primary value of being a member is unlimited access to several online courses. Additionally, members have access to guidance and support from industry professionals, as well as resources such as articles and videos.

September 2012 – December 2018 **College Tennis Team**, Founder, Instituto Superior Técnico, Lisbon, Portugal.
The official college tennis team is an organized group of individuals who are students at IST Alameda. This team is supported by the Students College Association, which is a student-led organization that helps to fund and promote the student's activities. The goal of the team is to encourage the practice of tennis within the IST Alameda campus. This means that the team is working to create opportunities for students, ex-students, teachers, and staff to come together and play tennis. The goal pf this team is to promote the sport of tennis and bring the community together through the shared love of the game.

September 2008 – Present **oppr Group**, Founder, Lisbon, Portugal.
Technological organization with projects in R&D, open source, healthcare solutions, software development and others fields. The ultimate goal of this organization is to provide a comprehensive and cohesive range of products, services, and solutions that will help businesses to improve their performance and add value to their operations. In order to achieve this goal, the organization maintains a focus on constant learning and development.

Volunteer

November 2016 **Web Summit 2016**, Operations Team - Survey, Lisbon, Portugal.
Working as Operations Team - Survey Volunteer at Web Summit, 2016. Assisting in gathering feedback from attendees and identifying areas for improvement through conducting surveys and analyzing data. Contributing to the overall success of the event.

Languages

Português	**Native proficiency**	*Mother language.*
English	**Professional working proficiency**	*Professional oral communication and writing.*
Spanish	**Limited working proficiency**	*Good oral communication but limited to write.*
French	**Elementary proficiency**	*Understand basic words and phrases only.*
Italian	**Elementary proficiency**	*Understand basic words and phrases only.*

Interests

- R&D
- Computer Science
- Entrepreneurship
- Web Development
- Open Source