Table of contents

From the Directors ................................................. 4
CMU Portugal at a glance .................................... 10
Timeline CMU Portugal Activities (2018-2019) ........... 28
Governance .......................................................... 32

Talent Development ............................................... 38
Dual Degree Ph.D. Programs .................................... 44
  Students .................................................................. 50
  Alumni ................................................................... 60
Mobility Programs .................................................. 72
  Visiting Faculty and Researchers Program .......... 74
  Visiting Students Program .................................. 78
Advanced Training Programs .................................. 90
Publications .......................................................... 92
Knowledge Creation ............................................... 98

Entrepreneurial Research Initiatives ......................... 102
Exploratory Research Projects ................................. 162
  ERPs 2017-2019 .................................................... 168
  ERPs 2019 .............................................................. 198
Large-Scale Collaborative Research Projects ............. 210
Innovation and Entrepreneurship .............................. 242
Industrial Affiliates ............................................... 244
Industry Involvement in Projects .............................. 245
Startups ................................................................. 248
Communication & Events ......................................... 262
New Image & Website ............................................. 270
Communication Activities ....................................... 278
Events and Outreach ............................................... 290
From the Directors

The mission of the Carnegie Mellon Portugal Program (CMU Portugal) is to place Portugal at the forefront of research and technological development in the area of digital technologies, with a particular focus on the data economy and foster interdisciplinary collaboration between industry and academia across different levels of the "big data" development stack.

CMU Portugal strive to be the main data-economy driver promoting an ecosystem with a tight coupling between cutting-edge research, world-class graduate education, and highly innovative companies. The overarching goal of the 3rd Phase is to foster industry-science relationships as agents of change with a focus on data economy and research for social and economic impact. Addressing these goals, the 3rd phase deployed a set of new instruments: i) **talent development** - revamping the dual-degree Ph.D. programs and launching a new generation of advanced executive training for companies while continuing to promote exchanges of faculty and students; ii) **knowledge creation** - by launching small seed funding research projects that bootstrap small-scale research...
collaborations leading to new areas of interdisciplinary research; iii) **innovation and entrepreneurship** - by establishing and renewing the industry affiliates program and launching a new call for industry-funded flagship projects which forms the basis for structural and finally iv) **communication and outreach** - by renewing the image of the program as a platform for international scientific collaboration that positions Portugal at the forefront of the Digital Economy and raising awareness about the potential of the country and its scientific community and digital ecosystem of companies to compete globally.

Since the renewal of the international partnerships in February 2018, the program's new leadership worked in repositioning the program towards its third stage. We (re)established the industry partnerships, namely by including as industrial partners several innovative companies operating in the digital economy, including some longstanding supporters of the program and three companies that reached the status of unicorns. We opened a call for scientific directors, which appointed eight young talented faculty members to assist the leadership in shaping the future of the partnership. We hired an amazing executive team that oversees the program's daily activities and works closely with faculty students and companies, making sure they have full support working with CMU Portugal. Finally, we continued the tradition of the program of continuously assessing and reviewing the progress and results of the funded projects.

2019 saw the launch of the new instruments planned for the 3rd Phase. On this year, ten new faculty and researchers completed visits to Carnegie Mellon University under our mobility program. In June, we launched the call for Large-Scale Collaborative Research Projects with industry, leading to the overall funding of 21M€ and ten projects. Still, in June 2019, we launched a call for Exploratory Research Projects funding seven projects in a total of 800K€. Finally, in October 2019, we opened the call for dual-degree Ph.D. scholarships and awarded a cohort of eight new students to the program, 13 in total in the 3rd Phase. During this period, the partnership promoted outreach activities with a particular emphasis on developing awareness about the Portuguese digital ecosystems and promoting gender balance.

We conducted all of these activities in a short period of time, and we ensured they were timely and effective from the launch of the call to the signing of the contracts and scholarships. We firmly believe that CMU Portugal is at the forefront of the instruments that FCT can promote to leapfrog the Portuguese science and technology system. The recent crisis is another example of the importance of interdisciplinary knowledge, science, and technology to overcome the continuous challenges of modern civilization. As we move into the second year of this program's leadership, we want to keep justice to the historical achievement of CMU Portugal and pave the way for a quick recovery and another period of impactful results.
The Carnegie Mellon Portugal Program (CMU Portugal) is a platform for education, research, and innovation that brings together Carnegie Mellon University (CMU) and several Portuguese universities, research institutions, and companies. Its mission is to place Portugal at the forefront of research and technological development in the area of Information and Communication Technologies (ICT), with a particular focus on the areas that have a direct impact on the data economy and foster interdisciplinary collaboration between industry and academia across different levels of the “big data” development stack. To achieve this goal, CMU Portugal works towards promoting an innovation ecosystem with a tight coupling between cutting-edge research, world-class graduate education, and highly innovative companies in the data-driven economy. The Fundação para a Ciência e a Tecnologia (FCT - the Portuguese Foundation for Science and Technology) supports the Program’s activities, which are also sponsored by the Conselho de Reitores das Universidades Portuguesas (CRUP) and co-financed by industry partners and by Carnegie Mellon University.

This partnership was launched in 2006, and is currently in its 3rd phase, which started in 2018 and will continue through 2030. The previous two phases, comprising the first 11 years of the Program, successfully promoted the development of talent and the internationalization of Portuguese Universities.
and fostered cooperation among universities and of university researchers with Portuguese companies, some of which emerged from this Program with a strong focus on entrepreneurship.

In this new phase, the goal is to focus on high-impact science, and technology that takes advantage of the extraordinary opportunities provided by the data economy as a driver of growth and change.

Leaning on Carnegie Mellon’s experience as a dynamic economic engine in the Pittsburgh region, CMU Portugal aims to foster in Portugal a flexible talent-rich labor market; a vibrant private sector catalyzed by the entrepreneurial spirit; strategic government investments in research and education; and implement infrastructure that fosters collaboration across traditional boundaries.

The overarching mission of 3rd Phase is to foster industry-science relationships as agents of change with a focus on data economy and research for social and economic impact. Addressing these mission statements will require interdisciplinary efforts, both within ICT areas and also across disciplinary boundaries.

On its 3rd Phase, the collaborative network of CMU Portugal extends across the Portuguese universities, represented by CRUP, Associate Laboratories in the area of ICT, and many other research institutions in Portugal, 10 CMU Departments, nearly 150 companies, and over 400 faculty and senior researchers in Portugal and at CMU. CMU Portugal has also established collaborations agreements with 14 new industrial affiliates, ICT leaders in Portugal and worldwide.

Principal Instruments of the Carnegie Mellon Portugal Program

| Talent Development |

In the scope of the CMU Portugal Program, Portuguese universities and Carnegie Mellon University offer Dual-Degree Doctoral Programs in the following areas: Computer Science, Electrical and Computer Engineering, Engineering and Public Policy; Human-Computer Interaction; Language Technologies; Robotics; Software Engineering.

Successful candidates to the CMU Portugal Dual-Degree Ph.D. Programs spend up to two years at CMU and up to three years at a University in Portugal. They are awarded two Ph.D. degrees, one by CMU and the other by the partner University in Portugal. In 2018–2019, two calls for Dual-Degree scholarships were open under the framework of the CMU Portugal. These scholarships include a monthly stipend and cover tuition fees in Portugal and at CMU. During 2018 and 2019, 14 scholarships were awarded to candidates...
candidates in Computer Science, Electrical and Computer Engineering, Engineering and Public Policy, Language Technologies and Software Engineering. Since 2006, 125 doctoral students and 247 master’s students have participated in the CMU Portugal Program. In the last call for admission for the 2020/2021 academic year, 8 scholarships were proposed to students at the following Ph.D. Programs: Computer Science (2), Electrical and Computer Engineering (3), Engineering and Public Policy (1), Language Technologies (1) and Software Engineering (1), bringing the number of currently enrolled Ph.D. Dual-Degree students to 133.

In addition to Dual-Degree Ph.D. students, the Program’s Entrepreneurial Research Initiatives (ERIs) have directly funded 35 Ph.D., for a total of 160 Ph.D. students directly supported by the Program.

The Program also included five Dual-Degree Professional Masters in the areas of Entertainment Technology, Human-Computer Interaction, Science Information Networking, Information Technology - Information Security, Software Engineering; and one Dual-Degree Professional Master/ MBA in Electrical and Computer Engineering.

Of our Dual-Degree graduates, 80% and 55% of Masters and Ph.D. alumni, respectively, have become part of leading organizations and companies. 4.82% of Master alumni and 38.46% of Ph.D. alumni currently are working for Renown Universities and research centers worldwide. Altogether, CMU Portugal alumni are agents of change, ambassadors for the excellence of the Program’s activities and facilitators of Portugal’s embedment in international knowledge and business networks.

CMU Portugal Mobility Programs support faculty, doctoral and Master students through an intensive immersion period at CMU to experience its educational, research, and cultural environment.

The Visiting Faculty and Researchers Program in Phase III builds upon the success of the Faculty Exchange Program of Phases I and II and is targeted to researchers that hold a doctoral degree. This initiative supports an extended exposure to research and education best practices at a global level, at Carnegie Mellon University. It fosters the integration of
faculty from Portuguese universities in international knowledge networks. **The Visiting Students Program**, an evolution from the previous Undergraduate Internship Program, provides an opportunity for talented master students to immerse themselves in a research project at Carnegie Mellon for up to 6 months. During this time, they have a chance to develop their knowledge and skills as researchers and explore new perspectives for graduate studies and career opportunities in cutting-edge ICT areas. Since 2018, CMU Portugal has opened two calls for visiting faculty and one call for visiting students, which have awarded mobility scholarships to 17 faculty and 9 master students from 8 different Portuguese institutions. Overall, CMU Portugal, through its Mobility Programs, has already supported 85 faculty and 50 students to experience life at CMU in all its components: learning, teaching, researching, and fully participating in its academic life. Besides these structured semester long stays at CMU, the Program has organized and sponsored numerous visits from CMU researchers to Portugal and from Portugal to CMU. Building on the success of the Dual-Degree master programs, which were active during the 1st and 2nd phases, the Program has been working in close collaboration with Universities in Portugal, CMU departments and industry partners to establish a new education instrument through **Advanced Training Programs** in Data Science and Machine Learning and User Experience Design. Both programs are expected to start in early 2021.

### Knowledge Creation

CMU Portugal supports research projects on the broad area of Information and Communication Technologies (ICT), with a particular focus on the areas that have a direct impact on the data economy and foster interdisciplinary collaboration between industry and academia across different levels of the “big data” development stack. This includes research topics spanning from **data science and engineering for large-scale data sets, to artificial intelligence, robotics, and machine learning** that enable extracting value from data, or to the sociotechnical systems and applications that are catalyzed through these technologies. In 2018 and 2019, 20 CMU Portugal projects, **12 three-year Entrepreneurial Research Initiatives (ERIs) and 8 one-year Exploratory Projects (ERPs)**, were supported across multiple Portuguese research institutions and CMU departments, strengthening the international collaborative effort across institutions and in close collaboration with industry partners. This commitment was further enhanced through the launch of two new calls for projects in 2019: a **call for new Exploratory Research Projects** and a **call for Large-Scale Collaborative Research Projects**, representing the largest public and private investment to date in research and technological development under the scope of the CMU Portugal Program.
Entrepreneurial Research Initiatives (ERIs) are science, engineering, management and policy projects that jointly combine research, innovation and advanced training initiatives, in collaboration with companies, with an emphasis on the commercialization of technology with an economic and societal impact. The projects have a maximum duration of 48 months and are managed by a consortium of research teams from two Portuguese universities, one from Carnegie Mellon University and at least one partner company. The 2013 and 2014 calls awarded 12 new grants with an overall funding of 10.8M€ public funding and 2.6M€ through private companies’ investment. Of these, five projects have ended in November and December 2018 and seven were still going in 2019. All projects supported by the CMU Portugal Program are selected through competitive calls by international committees of experts that evaluate the proposals submitted and meet as a panel in Portugal for their final evaluation, ranking, and recommendation for funding. The Program has also carried out mid- and final-term review of the progress of these projects. For example, in 2019, CMU Portugal held a project review evaluation by an independent international panel of experts to analyze the progress of all the twelve large research projects and conducted a mid-term of some and final assessment of the remaining group of projects. The independent committee awarded the classification A (maximum) to 4 out of the 5 projects that reached completion then. The impact of these ERIs on the economy and on society can be translated into 10 patents, development of 92 prototypes, 448 peer-review publications, 40 Ph.D. Thesis, 159 Master thesis and support fund for 204 researchers. ERIs have established collaborations extending to 26 Portuguese research institutions, 46 companies and 11 CMU Departments.

During 2018 and 2019, CMU Portugal supported 8 Exploratory Research Projects (ERPs). ERPs encourage new initiatives, with high impact potential, with the main objective of promoting Information and Communication Technologies projects in strategic emerging areas: Integrative research based in the context of the AIR Center, Data Science and Engineering, Computer Science, Electrical and Computer Engineering, Applied Mathematics and Technology, Management and Policy. The ERP call launched in 2017 recommended 8 one-year projects for funding, for an overall commitment of 1 430 000 €. The ERPs supported 28 researchers and resulted in 4 prototypes, 54 publications, 11 master thesis;
and involved 15 Portuguese research institutions and 4 CMU departments. A new call for ERPs was launched in 2019 to assist teams of researchers from Portuguese institutions, Carnegie Mellon University and industry partners, to bootstrap high-impact potential research activities of strategic relevance for the CMU Portugal Program. An overall funding of 820 000 € will support 7 new projects, out of 36 submissions, across 8 Portuguese research institutions and 4 CMU Departments.

In 2019, the most ambitious call for research projects was launched under the CMU Portugal Program. For the first time, the research projects are led by Portuguese companies and carried out in partnership between companies and non-corporate entities of the R&D System and research groups at Carnegie Mellon. The Call for Large-Scale Collaborative Research Projects was launched in May 2019 by ANI - Agência Nacional de Inovação with an initial funding available for 3 to 4 projects. Due to the high quality of the 17 proposals submitted, the evaluation panel recommended the funding of 10 projects for the next 3 years. Therefore, 10 new projects will start in 2020 led by top national ICT companies, including the CMU Portugal Program startups Feedzai and Unbabel - which are now reinvesting in R&D, Compta, Farfetch, First Solutions, Glintt, GLSMED Learning Health, Ingeniarius, Mobileum and Outsystems. In addition to these 10 companies, the projects will involve 18 other Portuguese Institutions, from Universities to Research Labs, Hospitals, and Companies plus 8 different Departments (Civil and Environmental Engineering, Computer Science, Engineering Research Accelerator, Heinz College of Information Systems and Public Policy, Institute for Software Research, Language Technologies Institute, Mechanical Engineering, Robotics Institute). Overall the call represents a commitment of 21M€ from public funding (PT2020 and FCT) and companies’ investment into ICT R&D.

In summary, since 2006, the CMU Portugal Program launched nine calls for research projects and has supported 55 R&D projects, to which we now add 10 Large-Scale, and 7 ERP to an overall number of 72 projects. In 2020, the new projects will further support CMU Portugal’s mission to place Portugal at the forefront of research and technological development in ICT. Throughout the year, 10 large-scale projects and 7 new ERPs will begin, representing the most significant public and private financial commitment to date under the scope of the CMU Portugal Program.
Innovation and Entrepreneurship

The 3rd Phase of the CMU Portugal Program aims at promoting an ecosystem of innovation in Portugal benefiting from Carnegie Mellon’s experience as a dynamic economic engine in the Pittsburgh region and also the collaborative opportunities at the campus in Silicon Valley.

The CMU Portugal Program has been working to establish a very close relationship with the Portuguese industry, namely through the companies that are part of its Industrial Affiliates Program. Since 2018, 14 CMU Portugal Industrial Affiliates have committed to actively contribute to the advanced education and research programs of the partnership and also to increase their competitiveness by investing in R&D, in advanced training of human resources, and in building a highly-skilled workforce dedicated to innovation activities. CMU Portugal Industry Affiliates includes 3 Portuguese unicorn companies (Farfetch, Talkdesk and Outsystems), 3 CMU Portugal startups (Feedzai, Unbabel, and Veniam) and ICT leaders (Accenture, Altice, CEiiA, NOS, Priberam, REN, Talkdesk, Tekever, Thales, and Uniplaces). Furthermore, Farfetch, Feedzai, Outsystems, and Unbabel reinforced their commitment to the Program by leading 4 out of the 10 CMU Portugal Large-Scale Projects that will start in 2020.
CMU Portugal has also been a hub for faculty members, students, and alumni to launch their entrepreneurial initiatives. The Program has supported the creation and development of 12 startups: Dognaedis, Feedzai, Geolink, Mambu, Orange Bird, Prisma, Red Light, Sentilant, Streambolico, Veniam and Unbabel. Together these companies have attracted more than 200M€ in venture capital investment and created over 1,000 highly qualified jobs and are already a reference in their activity sector, such as Feedzai, who is also part of the CMU Portugal Industry Affiliates, and Veniam. During phase II, CMU Portugal program supported 14 teams through the Entrepreneurship in Residence Program (inRes), a business acceleration program for entrepreneurial teams in the area of ICT. Some of these teams have developed into successful startups such as AddVolt, whose founders have been nominated on the prestigious list Forbes 30 under 30 in Manufacturing & Industry.

Since 2006, nearly 150 companies have been partners at CMU Portugal promoted projects. In this 3rd phase, CMU Portugal continues to strengthen the relationship between academia and industry. Leading ICT companies are partners in research projects. Still, they also positioned themselves as promoters and funding bodies of the projects, investing nearly 3.5 M€ in the Large-Scale Projects of the Program.
Communication and Outreach

CMU Portugal’s communication strategy supports the Program’s mission and goals outlined for this new chapter while recognizing the outcomes of the past. In 2018, the CMU Portugal unveiled a new graphic image and website that involved restructuring the website, rethinking its navigation, usage and cross platform support. By the end of the year, the Program also launched its first bi-monthly digital newsletter, “News from the Fence”, to promote its initiatives, including news, events, and CMU Portugal publications.

The Program’s communication is strongly focused on online activities beyond its website, such as social media networks (Facebook | Twitter | LinkedIn | Youtube) and also in press and media activities through press releases highlighting the Program’s research outputs and also faculty, students and alumni achievements. In between newsletters, targeted e-mail messages for specific audiences are used to send invitations to events, announce calls and other relevant pieces of information.

In 2018 and 2019, the CMU Portugal Program organized several events to bring together academic and industry communities involved in the Program, as well as raising awareness about its initiatives among new stakeholders and audiences. The showcasing of the outcomes of the Program continues to be a strong feature of these events, but also addressing broad questions in ICT such as workshops on gender balance and distinguished lectures on Artificial Intelligence and User-Centered Design.

CMU Portugal also took part in outreach events (such as Encontro Ciência and InCode) to interact with a broad public to disclose and promote the Program’s initiatives and activities.

Additionally, the Program organized high profile events to reach out to strategic stakeholders and entities, including members from the Portuguese Government, Ministry of Science, Technology and Higher Education, Fundação para a Ciência e Tecnologia (FCT), Carnegie Mellon University and CMU Portugal Governance among others.
Timeline CMU Portugal Activities (2018-2019)

February
Renewal of FCT International Partnerships
Establishment of an agreement for international cooperation in science, technology, and higher education within the Carnegie Mellon Portugal Program with 12 new industrial affiliates (two more companies have joined in 2019, totalling 14 industrial affiliates)
Carnegie Mellon Portugal Technical Workshops
- Over 140 attendees at workshops led by Portuguese and CMU researchers

July
Participation at Encontro Ciência 2018
Open call for applications for CMU Portugal scientific directors
- Selection of 8 new scientific directors

November
Launch of CMU Portugal new image and website

December
Open Call for the Dual-Degree CMU Portugal Program Scholarships
- 6 scholarships awarded
Participation at INCoDe Conference of the National Forum for Digital Competences
Timeline CMU Portugal Activities

February
The Minister of Science, Technology and Higher Education, the President of FCT and a delegation of 12 Portuguese Researchers visit Carnegie Mellon University

June
Open Call for Large-scale collaborative research projects
Open Call for Exploratory Research Projects

July
Participation at Encontro Ciência 2019
Presentation of the new ERP Call & 3rd phase Initiatives at CMU

October
Workshops on gender Balance in Stem (Porto and Lisbon)

November
Open Call for visiting faculty and researchers at CMU

December
CMU Portugal Scientific directors promote CMU Portugal activities at Carnegie Mellon University
CMU Portugal Distinguished lecture “Beyond User Centered Design”
CMU Portugal Scientific directors visit CMU
CMU Portugal Distinguished lecture “Towards a Conscious AI – A computer architecture inspired by cognitive neuroscience” (Porto and Lisbon)

March
CMU Portugal Project Review meeting
Photo and Video Exhibition of the Screen DR project at FCT
Open Call for visiting faculty and researchers at CMU

September
CMU Portugal organizes Welcome Reception for its Community in Pittsburgh
CMU Portugal at the International Day (IDay2019) from Instituto Superior Técnico
Governance

The CMU Portugal collaboration is based on a contractual arrangement between CMU and the Portuguese Science and Technology Foundation (FCT).

The program’s governance structure begins with the Board of Directors, who are responsible for policy oversight, approval of the annual plan and budget allocation for any proposed activities. An external review committee (ERC) shall review the specified objectives and may suggest changes. The Board of Directors, ERC, Program directors, scientific directors and the coordination office all work in conjunction as a unified body of leaders and manager to ensure that the program works effectively.

The Board of Directors comprises the following four members:

- **The President of the FCT or his/her designee (who shall chair the Board)**
- **A representative of the Portuguese University partner institutions participating in**
- **The CMU Portugal Program or his/her designee, designated by the FCT**
- **The President of CMU or his/her designee, and the Dean of CMU’s College of Engineering or his/her designee.**

In addition, one or more representative(s) of the main Industrial and Institutional Affiliates, may also be members of the Board. The Program Directors in Portugal and at CMU are non-voting members of the Board of Directors.

The ERC's duties shall consist of reviewing the CMU Portugal Program's programs (i.e., substantive scientific auditing and independent evaluation of the programs and the activities carried out and producing an evaluation report to the FCT and to the ICTI Board of Directors) and in connection therewith, may suggest specific changes. The ERC is comprised of four members who are independent members from the international scientific community (none of whom employed by FCT or CMU), and is appointed by and in the sole discretion of the FCT.
Board of Directors

Helena Pereira
President of the Board of Directors. President, Fundação para a Ciência e a Tecnologia (FCT)

Paulo Jorge Ferreira
Rector, University of Aveiro Representative of Council of Portuguese Rectors (CRUP)

James H. Garrett
Provost, Carnegie Mellon University

William H. Sanders
Dean of the College of Engineering at Carnegie Mellon University

Rogério Carapuça
President, Portuguese Association for Development of Communications (APDC) Representative of Industry

External Review Committee

Professor Sir John O’Reilly (Chairman)
University College London, United Kingdom Chairman, SERC, A*STAR, Singapore

John Guttag
Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology

Fernando Pereira
VP and Engineering Fellow at Google

Ali Sayed
Dean of Engineering, EPFL School of Engineering

Giulio Sandini
Senior Researcher, Founding Director, Italian Institute of Technology

Yvonne Rogers
Professor and Director, Centre of Excellence in Human-Computer Interaction, University College London
### Program Directors

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuno Nunes</td>
<td>National Director at Portugal</td>
</tr>
<tr>
<td>Rodrigo Rodrigues</td>
<td>National Director at Portugal</td>
</tr>
<tr>
<td>José M. F. Moura</td>
<td>Director at CMU of the Carnegie Mellon Portugal</td>
</tr>
</tbody>
</table>

### Scientific Directors

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joana Mendonça</td>
<td>Instituto Superior Técnico, Universidade de Lisboa</td>
</tr>
<tr>
<td>Fernando Velez</td>
<td>Instituto de Telecomunicações &amp; Universidade da Beira interior</td>
</tr>
<tr>
<td>Paulo Marques</td>
<td>CTO of Feedzai</td>
</tr>
<tr>
<td>João Paulo Cunha</td>
<td>Faculdade de Engenharia da Universidade do Porto</td>
</tr>
<tr>
<td>Rui Maranhão</td>
<td>Instituto Superior Técnico, Universidade de Lisboa</td>
</tr>
<tr>
<td>Luís Filipe Antunes</td>
<td>Faculdade de Ciências da Universidade do Porto</td>
</tr>
<tr>
<td>Susana Sargento</td>
<td>Universidade de Aveiro</td>
</tr>
</tbody>
</table>

### Coordination Office

#### Portugal office

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sílvia Castro</td>
<td>Executive Director</td>
</tr>
<tr>
<td>João Fumega</td>
<td>Education Officer</td>
</tr>
<tr>
<td>Mariana Carmo</td>
<td>Communications and Events Officer</td>
</tr>
<tr>
<td>Alexandra Mendes</td>
<td>Project officer</td>
</tr>
<tr>
<td>Mary Adelson</td>
<td>Administrative Coordinator</td>
</tr>
</tbody>
</table>

#### Carnegie Mellon office

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megan Flohr</td>
<td>Associate Director</td>
</tr>
<tr>
<td>Maya Colacito</td>
<td>Administrative Coordinator</td>
</tr>
<tr>
<td>Mary Adelson</td>
<td>Administrative Coordinator</td>
</tr>
</tbody>
</table>
Talent Development
The CMU Portugal Program has made a considerable effort in its 3rd phase to expand its educational initiatives. The objectives are to encompass different levels of education and to respond to new challenges based on a demand that has grown in the last years in ICT related topics such as big data, artificial intelligence (AI), and machine learning. The overarching strategy is to maintain legacy initiatives, that are a core component of the Program and a trademark of its excellence, but also aims to introduce new initiatives that broaden the audience of the Program while respond to particular challenges that societies now face.

In the period that comprises this report between 2018-2019, the Ph.D. Program in Human-Computer Interaction was added to the Dual-Degree Ph.D. Programs, and the Ph.D. Programs in the Technological Change and Entrepreneurship and Applied Mathematics were concluded. The Ph.D. Programs requirements were also revised. During CMU Portugal’s 2nd phase it was mandatory for students’ to develop their thesis within the topics of specific research projects, now students can explore a research topic within one of the main areas of interest of the CMU Portugal Program, which broadens the research produced via doctoral thesis. Simultaneously, there was an effort to increase the number of awarded scholarships, reflected already in the 2019 call for admissions, and reinforced in the 2020 call.
The Mobility Programs are a key educational strategy of the Program and have successfully attracted both students and faculty since the 2nd phase of the Program. During the 3rd phase of the Program, these initiatives suffered significant changes. On one hand, the Visiting Students Program (which builds upon the Undegraduate Internship Program) now focuses on master students, preferably in the 2nd and final year of their master, instead of targeting students in the first year of their degree. This change has the objective of creating a transition process in which master students, future Ph.D. candidates, will have already experienced CMU academic life, and had the opportunity to establish networks and contact with high-quality research and teaching, which will strengthen their application to the Ph.D. Programs. Also, actions were taken to increase the visiting period of these initiatives (up to 4 months for faculty and up to 6 months for students), and the total number of visiting students and faculty that visits CMU each year.

Finally, the Program has also been designing the Advanced Training Programs in Data Science and Machine Learning and Human-Computer Interaction, which are a new educational initiative whose goal is to provide a response to practical ICT related problems that companies face nowadays through a combination of new educational methods and cutting edge tools. It was designed based on the past experience of the Dual-Degree Master Programs that are now concluded, and was a response to a growing need that the Program faced by its industrial affiliates of a more targeted, practical, and short duration training program. The Advanced Training Programs are being designed in partnership with Universidade de Lisboa (FCUL and IST) and Universidade Nova de Lisboa (FCT-UNL), and they are expected to launch in the beginning of 2021.

To summarize, the main educational strategy for the 3rd phase of the Program will be to broaden the educational initiatives portfolio in order to increase the outreach and contribution of the Program to the society: for master students to have a first contact with a different social and cultural environment, world class faculty and infrastructure to progress towards the Ph.D.; for Ph.D. students to have the unique opportunity of having a Dual-Degree between Portugal and the U.S.; for scholars to establish or reestablish research networks with other colleagues that could enable a joint research project, publication or other collaboration; for workers in ICT related areas that want to get to know the latest tools, models and cutting edge knowledge in a specific topic and apply it in their company.
Dual-Degree Ph.D. Programs

Since 2006, the CMU Portugal Program supports the Dual-Degree Ph.D. Programs. Between 2018-2019 the Program has opened 3 calls for scholarships (2018/2019, 2019/2020 and 2020/2021) for the following areas: Computer Science, Electrical and Computer Engineering, Engineering and Public Policy, Human-Computer Interaction (for 2020/2021), Language Technologies, Software Engineering, and Robotics, in a collaboration between 6 Portuguese Universities with various departments at CMU.

Students in the Dual-Degree Program are actively registered in both Universities and conduct their studies both in Portugal and in the United States. The CMU Portugal Program, through FCT, provides scholarships that cover up to 5 years of funding, 3 years in Portugal and 2 years at CMU. Students are co-advised by faculty from Carnegie Mellon University and from Portuguese partner higher education institutions. Graduates of the program receive Dual-Degree conferred by CMU and the affiliated Portuguese University.

Admission in the Dual-Degree Ph.D. Programs is highly competitive. The CMU Portugal candidates need to present an application directly to CMU and be evaluated together with all the candidates that are applying to that specific Ph.D. Program from all over the world.
If they meet the minimum requirements for admission, they are forwarded to an admissions committee in Portugal, constituted by faculty from various Portuguese higher education institutions, CMU faculty and chaired by the Directors of the Program. They will evaluate the applications for the awarding of the FCT – CMU Portugal scholarship. If the candidate attains the required evaluation to be considered for the Program, he/she will be proposed for admission to the relevant CMU and Portuguese University departments and also to FCT for scholarship funding.

The Dual-Degree Program provides a unique opportunity for students to experience the advantages of collaborative research between top-tier research institutions. The Program’s high scientific standards have served and are expected to educate high-quality researchers, instructors, and innovators in ICT related areas for CMU Portugal’s 3rd phase.

### Degree

<table>
<thead>
<tr>
<th>Degree</th>
<th>CMU</th>
<th>IST</th>
<th>FEUP</th>
<th>FCUL</th>
<th>UA</th>
<th>FCTUC</th>
<th>UMinho</th>
<th>FCT-UNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. CS-Robotics</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. EPP</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. ECE</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. CS</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. LTI</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. SE</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The 3rd phase of the CMU Portugal Program introduced important changes: in the admission process and in the increasing number of scholarships available, which can already be assessed in the following graphic where it is shown an increase of the number of enrolled and active students in 2019. Since 2007, 125 students have enrolled in the Dual-Degree Ph.D. Program, with 23 current active students. The number of students enrolled since 2018, considering already the 2020 cohort which saw 8 new students enrolling in the Program, can be translated into more enrolled students/year on average (4.6) than the previous phase (4.1).

From the 78 alumni of the Program only 5 are from calls that were launched during the 2nd phase of the Program, 24 students (19%) have withdrawn, suspended, or are in medical or parental leave.
Regarding the number of enrolled students in each Ph.D. Program, the Electrical and Computer Engineering (ECE) and Engineering and Public Policy (EPP) Programs concentrated the majority of the enrolled students. Since 2018, the distribution of enrolled students across the Ph.D. Programs has been more heterogeneous, with an important number of students also enrolled in Language Technologies and Software Engineering. This tendency was also registered and reinforced in 2020. In 2020, from the 8 students enrolled in the Ph.D. Programs, 3 enrolled in Electrical and Computer Engineering, 2 in Computer Science, 1 in Engineering and Public Policy, 1 in Software Engineering, and 1 in Language Technologies.
From the 125 enrolled students, 41% were hosted in the Department of Electrical and Computer Engineering, 26% in the Department of Engineering and Public Policy, and 10% in the Department of Computer Science. The remaining students were enrolled in the Institute for Software Research, Language Technologies Institute, Department of Mathematical Sciences, School of Public Policy & Management, Robotics Institute, and Department of Social and Decision Sciences. In Portugal, 59% of the students were enrolled in the University of Lisbon, 24% in the University of Porto, and the remainder in the Universidade de Aveiro, Universidade de Coimbra, Universidade Católica Portuguesa, and Universidade Nova de Lisboa.
Regarding the nationality of the students enrolled in the Program, 52% are from Portugal, 21% from Asia and the Middle East and 14% from North America. The remaining students are nationals from countries located in South America, Europe or Africa, which illustrate the relative diversity of the students within the Program. One important aspect is the overall high number of Portuguese students, which acknowledges the quality of the Portuguese higher education system. Between 2018 and 2019, of the 6 students that were admitted and have enrolled, 3 are from North America (United States of America), and 3 are from Portugal. In 2020, of the 8 students admitted, 7 are Portuguese and 1 is from the United States of America. Regarding gender balance, 20% of the students are women, the majority of them (16) enrolled in the CMU Portugal 1st phase.
Alex Gaudio  
Cohort: 2018/2019

Ph.D. Program: Electrical and Computer Engineering  
Ph.D. Research Topic: Explainability in AI for Medical Imaging  
Affiliation: FEUP and CMU  
Supervisors: Aurélio Campilho (FEUP), Asim Smailagic (CMU)

I authored four peer-reviewed works that contribute towards the topic of explainability in AI for medical image analysis. My recently accepted work on Pixel Color Amplification explains mathematical relationships between four methods derived from dehazing theory and develops a family of interpretable image enhancement methods. These novel image enhancements significantly improve predictive performance on retinal fundus image segmentation tasks, demonstrate that color values cause large differences in performance, and are visually stunning. In the following two years of my Ph.D., I intend to expand on my advisors’ and my existing works, and place special emphasis on explainable analysis of Lung Radiography data.

Luis Borges  
Cohort: 2019/2020

Ph.D. Program: Electrical and Computer Engineering  
Ph.D. Research Topic: Neural Information Retrieval  
Affiliation: IST and CMU  
Supervisors: Bruno Martins (IST), Jamie Callan (CMU)

Currently, I am doing coursework in Portugal and working on neural methods for tackling the MSMARCO passage ranking task. For the following two years, I will be doing coursework in Pittsburgh and also continuing my research on the aforementioned topic. My last two years will be in Portugal, where I will be doing directed research only.

Maria Casimiro  
Cohort: 2019/2020

Ph.D. Program: Software Engineering  
Ph.D. Research Topic: Resilient and Adaptive Machine Learning based Systems  
Affiliation: IST and CMU  
Supervisors: Paolo Romano (IST), David Garlan (CMU)

I believe the work I will develop during my Ph.D. has the potential to impact multiple sectors, ranging from autonomous vehicles and robots to fraud detection and medical diagnosis systems. I expect this to be a thrilling journey, and in particular one that allows me to substantially expand my knowledge in Software Engineering.
**Dual-Degree Ph.D. Programs**


**Diogo Cardoso**  
Cohort: 2019/2020

**Ph.D. Program:** Electrical and Computer Engineering  
**Ph.D. Research Topic:** Improving the efficiency of distributed optimization algorithms  
**Affiliation:** IST and CMU  
**Supervisors:** João Xavier (IST), Yuejie Chi (CMU)

My research work focuses on developing distributed algorithms with faster convergence rates that require less communications between agents, alongside with the concern of determining and proving theoretically the conditions in which their convergence to the result of interest is certain. To be a part of the CMU Portugal program while working on this engineering topic represents an unparalleled opportunity for my research. On the one hand, I expect that the direct contact with leading experts and the newest developments in this area will impact greatly my work and the way I approach research. On the other hand, I expect that the conditions gathered by this program, such as the time divided between two top-tier institutions, will turn out to be very enriching for my personal and academic development.

**Neil Mehta**  
Cohort: 2019/2020

**Ph.D. Program:** Electrical and Computer Engineering  
**Ph.D. Research Topic:** Developing and applying machine learning techniques for non-invasive neuro-stimulation and neuro-sensing problems for applications in stroke rehabilitation, chronic pain management, and prosthetic control  
**Affiliation:** IST and CMU  
**Supervisors:** Patrícia Figueiredo (IST), Pulkit Grover (CMU)

Currently, I am heavily involved in two projects – one with a goal in focusing currents in the brain to recruit specific cortical cell types on a sub-micron resolution scale. The second is more broadly focused on developing high resolution invasive spinal cord stimulation techniques for fine motor control and potentially disruption of afferent pain-carrying fibers. In the coming years, I hope to gain an understanding of the different neural representations of data that exist and apply this knowledge towards developing more biologically plausible and useful deep learning models.

**Rudolph Sanatorromana**  
Cohort: 2019/2020

**Ph.D. Program:** Engineering and Public Policy  
**Ph.D. Research Topic:** Deep decarbonization of economic sectors  
**Affiliation:** IST and CMU  
**Supervisors:** Joana Mendonça (IST), Granger Morgan (CMU)

Regarding the following years, I plan to develop simulations, data analyses, technology assessments, and policy recommendations to develop a low-carbon economy.
Dual-Degree Ph.D. Programs: Alumni

Alumni by Ph.D. Program and graduation year

Considering the alumni average off each phase of the Program, the 1st phase I (only two years with alumni) had an average of 5 alumni/year, the 2nd phase an average of 10.6 alumni/year and the 3rd phase (with 3 years), is currently with an average of 7.5 alumni/year.

On average 38% of the alumni finished the Ph.D. in the expected timeline of 5 years and 28% in 6 years. Taking into account the number of enrolled students previously mentioned, the majority of the alumni graduated in Electrical and Computer Engineering (38%) and in Engineering and Public Policy (22%). Also important, especially at the beginning of the 2nd phase of the Program, the number of graduates in TCE (18%). EPP is the Ph.D. Program with the highest completion rate (77%) together with Applied Mathematics with 100% (in this case only two students in total were enrolled and graduated). All of the other Programs have completion rates above 50%. Software Engineering is currently an exception as from the 3 students enrolled, 1 has graduated, and 2 are still active pursuing their Ph.D.
From the 78 alumni, 40% were hosted in the Department of Electrical and Computer Engineering, 22% in the Department of Engineering and Public Policy, and 10% in the Department of Computer Science. The remaining students were enrolled in the Institute for Software Research, Language Technologies Institute, Department of Mathematical Sciences, School of Public Policy & Management, Robotics Institute, and Department of Social and Decision Sciences. In Portugal 60% of the students were enrolled in the Universidade de Lisboa, 23% in the Universidade do Porto, and the remainder in the Universidade de Aveiro, Universidade de Coimbra, Universidade Católica Portuguesa and Universidade Nova de Lisboa.
Dual-Degree Ph.D. Programs: Alumni

| Nationality and gender |

<table>
<thead>
<tr>
<th>Region</th>
<th>Alumni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portugal</td>
<td>36</td>
</tr>
<tr>
<td>Rest of Europe</td>
<td>11</td>
</tr>
<tr>
<td>Asia and Middle East</td>
<td>18</td>
</tr>
<tr>
<td>Africa</td>
<td>1</td>
</tr>
<tr>
<td>South America</td>
<td>3</td>
</tr>
<tr>
<td>North America</td>
<td>9</td>
</tr>
<tr>
<td>Rest of Europe</td>
<td>11</td>
</tr>
<tr>
<td>Asia and Middle East</td>
<td>18</td>
</tr>
<tr>
<td>Africa</td>
<td>1</td>
</tr>
<tr>
<td>South America</td>
<td>3</td>
</tr>
<tr>
<td>North America</td>
<td>9</td>
</tr>
</tbody>
</table>

Regarding the alumni nationality, 46% are Portuguese, 23% are from Asia and the Middle East countries, 14% from other European countries and 12% from North America (all from the United States of America). The remaining alumni are nationals from countries located in South America, and Africa. Of the alumni population 18% are women and 82% are men.
Dual-Degree Ph.D. Programs: Alumni

Alumni job positions by type of employer and country of employment

In what concerns alumni job positions by type of employer and country of employment, it was possible to complete the information for 74 of the 78 alumni. From those, 40 alumni (54%) are working in the U.S., of which 14 are Portuguese. Many alumni in the U.S. are working in companies that are a reference in their area of activity (such as Samsung, Google, Duolingo, JP Morgan) and top-tier universities (such as Carnegie Mellon University, University of California, University of Chicago, Princeton University).

The majority of the alumni that work in the U.S. are working in industry (55%) followed by academia (38%) and governmental institutions (7%). Apart the U.S., the most prominent job location for the CMU Portugal alumni base is Portugal, which accounts for 20% of the total alumni. In Portugal, the share of alumni working in industry is even higher than in the U.S. (60%), and most of them work in Portuguese ICT related companies such as DefinedCrowd, Feedzai, Piberam, Unbabel, Synopsys and NOS. A large share of the alumni work in other European countries (17%), and in these cases the predominant type of employer is the academia (54%), followed by industry (38%), and non-governmental institutions (8%). In these cases, alumni job positions range from Utrecht University, Erasmus University and Eindhoven University to Google, Amazon, and the European Commission. The majority of the alumni that work in Asia and the Middle East is working in companies (72%) such as IBM, Alibaba or Mujin.

Legend

- Government
- University
- Industry
- Non-Governmental

54% of total
15 (38%)
22 (55%)

17% of total
5 (38%)

13 Rest of Europe
6 (40%)

17% of total
7 (54%)

13 Rest of Europe
6 (40%)

15 Portugal
9 (60%)

15 Portugal
9 (60%)

7 Asia and Middle East
9 (60%)

17% of total
5 (14%)

7 Asia and Middle East
9 (60%)

17% of total
5 (14%)

Talent Development - Dual-Degree Ph.D. Programs
Dual-Degree Ph.D. Programs: Alumni

| 2018 and 2019 alumni |

João Semedo
Postdoctoral Research Associate at Professor Yu's Lab (CMU)

Ph.D.: Electrical and Computer Engineering
Affiliation: IST/CMU
Graduation year: 2018

My experience working at Professor Yu’s is being absolutely fantastic! He is really inspiring, both professionally and personally. The lab does leading work in systems neuroscience and is composed of very talented people, who are great to work with every day.

Alexandre Ligo
Postdoctoral associate at CMU and Visiting Faculty at Indiana University South Bend – Judd Leighton School of Business and Economics

Ph.D.: Engineering and Public Policy
Affiliation: FEUP/CMU
Graduation year: 2018

Filipa Reis
Invited Assistant Professor of Data Science at Católica Lisbon School of Business and Economics

Ph.D.: Technological Change and Entrepreneurship
Affiliation: FEUP/CMU
Graduation year: 2018

Rui Correia
Lead Machine Learning Engineer at DefinedCrowd

Ph.D.: Language Technologies
Affiliation: IST/CMU
Graduation year: 2018

Above all, it’s a privilege to be part of the CMU Portugal Program. The experience of pursuing your Ph.D. in two different institutions, surrounded by two very distinct social and cultural surroundings was incredible.

Jayakorn Vongkulbhisal
Research Scientist at IBM Research, Tokyo

Ph.D.: Electrical and Computer Engineering
Affiliation: IST/CMU
Graduation year: 2018

Soheil Hooshangi
Assistant Professor at Bryan School of Business and Economics

Ph.D.: Technological Change and Entrepreneurship
Affiliation: Católica/CMU
Graduation year: 2019

Shanghang Zhang
Postdoctoral researcher at Carnegie Mellon University

Ph.D.: Electrical and Computer Engineering
Affiliation: IST/CMU
Graduation year: 2018
**Zita Marinho**  
Researcher at Priberam Labs  

Ph.D.: Computer Science/Robotics  
Affiliation: IST/CMU  
Graduation year: 2018  

"My Ph.D. experience was very enriching, I had the chance of meeting and collaborating with other students and great researchers at CMU. It was very motivating and inspiring to be a part of my research lab, and the campus provides a very intense and thriving student life.

**Xuanle Ren**  
Research Scientist at Alibaba Group  

Ph.D.: Electrical and Computer Engineering  
Affiliation: FEUP/CMU  
Graduation year: 2018

**João Saúde**  
AI Research Scientist at JPMorgan Chase & Co.  
Ph.D.: Electrical and Computer Engineering  
Affiliation: IST/CMU  
Graduation year: 2018

**José Rodrigues**  
Computer Vision Technical Lead at Mujin Inc.  
Ph.D.: Electrical and Computer Engineering  
Affiliation: IST/CMU  
Graduation year: 2018

**Senbo Fu**  
Collaborator PhD Researcher at ISEP  
Ph.D.: Electrical and Computer Engineering  
Affiliation: FCUP/CMU  
Graduation year: 2018

**Luís Miguel Pinto**  
Computer Vision Technical Lead at Mujin Inc.  
Ph.D.: Electrical and Computer Engineering  
Affiliation: FEUP/CMU  
Graduation year: 2018

**Baojiang (Chris) Yang**  
Data scientist at Houzz  
Ph.D.: Electrical and Computer Engineering  
Affiliation: FCUP/CMU  
Graduation year: 2018

**Tiago Pereira**  
Design Engineer at ASML  
Ph.D.: Electrical and Computer Engineering  
Affiliation: FEUP/CMU  
Graduation year: 2019

---

**Talent Development - Dual-Degree Ph.D. Programs**

---

**Annual Report 18/19 - Carnegie Mellon Portugal**

---

**68**
The Visiting Faculty and Researchers Program and the Visiting Students Program have been and continue to be key educational initiatives of the CMU Portugal Program. They have contributed to the strengthening of the research networks that exist between the Portuguese Universities and CMU.

Since 2007, and considering the visiting students and faculty that were admitted in 2020, 85 faculty affiliated to Portuguese higher education institutions have participated in the Visiting Faculty and Researchers Program and 49 students under the Visiting Students Program. In regards to the Visiting Faculty and Researchers Program, of the 85 participants, 28 went on to participate in a CMU Portugal research project as PI’s or researchers and/or have supervised Dual-Degree Ph.D. students. As for the Visiting Students Program, only 2 students who have visited CMU enrolled in the Dual-Degree Ph.D., which is why the Program’s strategy for its 3rd phase is to target master students, preferably in the 2nd year of the master, to establish a coherent transition between the master and the Ph.D., should the student decides to continue his or her education.

Each year in average, and from 2007 to 2019, 10 faculty and/or students visited CMU. The average length of the visits is 3 months for the Visiting Faculty and Researchers and 4 months for the Visiting Students Program. Since 2018, there have been two calls for the Visiting Faculty and Researchers Program (in 2018 and 2019). The 2018 call admitted 11 that visited CMU during 2019. The 2019 call, resulted in 6 faculty accepted with visits scheduled for 2020. As for the Visiting Students Program, a call was open in 2019 being that 9 students were selected to visit CMU in 2020.
The Visiting Faculty and Researchers Program & Visiting Students Program

Number of visits per year

<table>
<thead>
<tr>
<th>Year</th>
<th>Visiting Faculty and Researchers Program</th>
<th>Visiting Students Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2008</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>2010</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>2011</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>2012</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2013</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2014</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2015</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2016</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>2017</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2018</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Male and Female breakdown:
- Visiting Faculty and Researchers Program: 57 Male, 22 Female
- Visiting Students Program: 30 Male, 10 Female
In regards to the visiting faculty host department at CMU, and considering the visits until 2019, 79 visiting faculty had the opportunity to collaborate with a CMU counterpart in research, co-teaching and other academic activities. From those, 27% were hosted in the Department of Electrical and Computer Engineering, 18% in the Institute for Software Research, 14% in the Department of Computer Science, 13% in the Human-Computer Interaction Institute, and the remaining in various departments and institutes as it can be seen in the figure. Regarding the affiliation to the Portuguese higher education institution 20% of the visiting faculty were affiliated to Universidade de Lisboa, 19% to the Universidade de Coimbra, 19% to the Universidade do Porto, 13% to the Universidade da Madeira, 10% to the Universidade de Aveiro, and the remaining to other Universities and Polytechnics Institutes in Portugal as it can be seen in the figure.
Visiting Students Program

By host CMU Departments and Portuguese Universities

- **Computer Science Department**: 14
- **Electrical and Computer Engineering**: 12
- **Robotics Institute**: 4
- **Language Technologies Institute**: 3
- **Engineering and Public Policy**: 2
- **Institute for Software Research**: 2
- **Mechanical Engineering**: 2
- **Computational Biology Department**: 1

In regards to the visiting students host department at CMU, and considering the number of visits until 2019, 40 visiting students had the opportunity to attending courses, participating in research projects and immersing in the CMU community. From those, 35% were hosted in the Department of Computer Science, 30% were hosted in the Department of Electrical and Computer Engineering, and 10% were hosted in the Robotics Institute. The remaining visiting students were hosted in various departments and institutes as it can be seen in the figure. Regarding the affiliation to the Portuguese higher education institution, 43% of the visiting students were affiliated to the Universidade de Lisboa, 38% to the Universidade do Porto, 10% to the Universidade de Coimbra, and the remaining to other Universities and Polytechnics Institutes in Portugal, as it can be seen in the figure.
Visiting Faculty Program

Petia Georgieva
Assistant Professor | Universidade de Aveiro

Host at CMU: Pei Zhang
Host Department: Electrical and Computer Engineering
Research Area: Machine Learning, Control Systems, System Theory, Deep Learning

“We have worked on product label recognition in autonomous stores. [...] We have proposed an Optical Character Recognition (OCR) approach for label detection and transcription from natural scene images, not specifically taken for product characterization. This is the first autonomous store system that considers an OCR sensing modality, to the best of our knowledge. This is a step toward a closer approximation to the natural way humans acquire information in product purchase activity. [...] In the framework of the course on Mobile and Pervasive Computing given by Dr. Pei Zhang I gave a lecture on Machine Learning, Data Collection and Sensor fusion. I have updated my lectures and labs for the course on Machine Learning, as an outcome of this activity. I teach in the University of Aveiro, based on Python programming. I have also prepared a new course on Deep Learning based on Tensorflow and Keras programming environments for Deep Learning models development. In conclusion, this was a very fruitful and successful professional period for me.”

Andreia Mordido
Invited Assistant Professor | Universidade de Lisboa (FCUL)

Host at CMU: Frank Pfenning
Host Department: Computer Science
Research Area: Probabilistic logic, Probabilistic satisfiability, Type theory, Formal methods

“As initially planned, our research work focused on the equivalence of session types with type constructors. Our main purpose was not only to analyze the decidability of this problem but also to propose a practical algorithm to decide it and to be integrated into a compiler. [...] Inspired in existing work on the equivalence of languages generated by deterministic pushdown automata (DPDA), we have proposed a transformation on session types with (n-ary) type constructors that ensures they become normed after the transformation. [...] Currently, we are working on the incorporation of the algorithm to decide the bisimilarity of simple grammars, that I proposed to the TACAS 2020 conference, with Pfenning’s current parser for session types with arithmetic refinements. [...] During my visit to CMU, I presented my previous and ongoing work in the PoP seminar, hosted by the Principles of Programming group at the Computer Science Department. [...] With this program, I had the opportunity to present and integrate my work in another setting and, hopefully, and ultimately, it will allow me to contribute to a better understanding of the problem of equivalence of session types with type constructors and their connection to DPDA’s. I do not consider this program is over. I instead feel it is present in my life every single day, either through the work I have continued to carry out with Frank Pfenning, Ankush Das, and Henry DeYoung, or through the regular meetings we have had since I arrived in Portugal.”
“The activities considered during the 3 month-period spent at the Soft Machines Laboratory (SML) [...] are summarized: [in what regards laboratory efforts] “Understand the hierarchy of molecular, microscale, and mesoscale structures and ordering of Liquid Crystal Elastomers (LCE); Define the protocol for the preparation of the LCE for the current experiments, based on existing protocols; Define the protocol for the inclusion of Liquid Metal in LCE matrix for a soft multifunctional composite (suitable for sensing, mechanically robust electronic connectivity and active shape morphing); Characterize thermally and topographically the compliant and deformable LCE matrix that can achieve macroscopic shape change through a liquid crystal phase transition; Define a new protocol for the inclusion of Phase Change Materials (PCM) in the LCE matrix, for thermal management; Design and fabricate individual planar thermal microactuators by laser depaneling, separation, and singulation; Experimental tests (experimental mounting, Infrared imaging, Matlab scripts for acquisition and data analysis); Public presentation of the results and discussion.” The visiting faculty also attended various seminars, training courses and visited other facilities related to the research area.

[...] The focus of my research work was on program synthesis. [...] Our research work focused on automatically generating programs based on input-output examples. The work was divided into three main tasks: (1) automatic generation of data transformations in R and SQL, (2) automatic generation of data transformations from visual elements in the examples, and (3) disambiguation of the programs generated in a program synthesis tool. First, a new tool for generating programs for table transformations in R and SQL was developed. Given a database with several tables and the expected output table, our tool is able to generate the necessary sequence of operations (in R and SQL) to produce the output table provided by the user. The tool SQUARES is available for download at https://squares-sql.github.io/. [...] We have also worked on a new framework for table transformations, where the user provides a chart instead of an output table. [...] A paper submission on this work is being finalized. [...] The third task focused on the disambiguation of programs. Note that in a program synthesis tool there might be several programs that satisfy the user specification. Therefore, we plan to use model checking techniques for automatic test generation to find new input examples where the program’s found by the synthesizer differ on the output. Next, interaction with the user follows to remove the undesired programs. Instead of asking the user for additional examples, the goal is to generate those examples automatically to disambiguate the programs. I would like to thank the CMU-Portugal program to support the advancement of this new line of research. This will have an impact on the teaching activities at the Computer Science Department at IST, as well as on the research at INESC-ID.”
“The developed research work has resulted not only in the preparation of three publications but also on the first steps to ensure a future implementation of the designed algorithms. The objective is to continue the collaboration to ensure in the short term the implementation of the management algorithms in a building management system using VOLTTRON (https://volttron.org/) as software platform and conduct a pilot at the University of Coimbra. To ensure it, the objective is to submit a proposal for the next call for research projects. This visit was very important to the future development of my career since it allowed me to develop research and academic activities in an institution implementing cutting-edge research and world-class education, as CMU. This contact with new cultures and best practices in research will be fundamental do define new research lines and objectives for my research group.”

—Ivan
Assistant Professor I Universidade de Coimbra

“...I was involved in several meetings regarding a VR project aiming to train amputees for the use of prosthetic limbs. The project involves the capture of bio-signals (myo-armband) and the use of VR to train the use of prosthetic, avoiding muscle atrophy, and providing training while expecting prosthetics under development. It involves bio-signal capture, classification, and creation of VR serious games (currently a preliminary demonstration simulates a shopping activity). I was involved in several meetings within the “prosthetic project” led by CMU hosts. During one of these meetings, I present the work under development at the University of Aveiro in this area. [...] I also gave several AR industry projects taking place in Aveiro. I also had meetings with Chris Harrison and Adam Perer that teach courses similar to those I teach in Aveiro, respectively, “Design of Human Computer Software” and “Information visualization”. We shared material and experiences teaching these topics and gave me the possibility to assist in some classes. One of the significant benefits of being at the CMU campus, was the number of talks, Ph.D. proposals and defenses taking place regularly in the most various topics. I had the chance to assist many of them. [...] Besides this, the experience of leaving abroad immersed in a different culture and to meet new people is always an enriching experience from a personal and professional point of view. From the less positive side, I would say that finding a host at CMU was not very easy and I would have expected additional help from the program to get in touch with potential hosts [...] Overall it was a wonderful experience professionally and personally, and I’m grateful to CMU Portugal program to provide me this opportunity.”

—Paulo Dias
Assistant Professor I Universidade de Aveiro
“The opportunity to collaborate with CCBI allowed me to study novel approaches to the analysis of real-time functional Magnetic Resonance Imaging (fMRI) neurofeedback data. [Regarding the classification of emotional imagery in ASD], “results suggest that i. discriminability of the neural activation based on this paradigm is possible using multi-voxel pattern analysis (MVPA) – mean rank accuracy 71.7% (considering the control group), and ii. neural signatures of emotion imagery changes / and discriminability of emotions improves after the neurofeedback training in the clinical population tested [...] [Regarding changes in functional connectivity after the neurofeedback training] Preliminary results obtained during the visiting period, suggest that there are changes in the functional connectivity between the baseline and the transfer measurements. Moreover, a measure of average connectivity in the network [...] shows that connectivity in the networks analyzed increased in all tasks. [...] During the visit, two presentations were hosted within CCBI. During this period, I also attended multiple research meetings with faculty and students, industrial partners, that I believe may represent future collaborators. CMU Portugal program also provided the opportunity to attend seminars, and meet some of the most influential researchers in multiple research fields. Two manuscripts presenting these research developments are being prepared in collaboration. [...] The success of the visit is reflected in the tangible outcomes of this period, namely the research developments (and possible future collaborative publications) and a very positive personal experience. Moreover, the success of the program may pave the way for future collaborations between CIBIT (UC) and CCBI (CMU).”

“...The main purpose of this visit to the Human-Computer Interaction Institute Department at Carnegie Mellon University was to target future collaborative research in the quality of life topic. The specific objectives of this visit were: (a) to establish stronger links with the Quality of Life Technology research group of CMU, enabling synergies and networking to promote collaborative research projects in Madeira, Portugal; (b) to acquire new skills/collaboration through examples of good teaching practice at Carnegie Mellon University, and (c) to work on research papers to be submitted during the year 2019. [Regarding the promotion of collaborative research projects], it was developed and submitted a proposal entitled “Assisted Living Technologies for Healthy Ageing” to Europe under the call “Work Programme for Research & Innovation 2018-2020”, namely, Health, Demographic Change, and Wellbeing. [On the topic of examples of good teaching practice at CMU], several meetings with professors Daniel Siewiorek and Asim Smailagic from the Human-Computer Interaction Institute Department were performed. In those meetings, there were discussed research practices, and examples of good teaching practice. [Regarding research papers to be submitted] an article entitled “The Efficacy of a Multicomponent Functional Fitness program based on Exergaming on the Cognitive Function of Healthy Older Adults: a randomized controlled trial” was written.”
“Regarding research, I worked mainly with Professor Jason Hong’s research group (Chimps Labs) on a MementoKey project over the passwords generation system in Cybersecurity and privacy in the area of Human-Computer Interaction (HCI). This lead to the opportunity to also collaborate on a project over a privacy manager with his research group. Currently, we are collecting data. Consequently, we expect the result to be published in international journals by the end of 2020, the beginning of 2021. Moreover, I participated in periodic research meetings, where I had the chance of being involved in productive discussions over the work done at the HCII, particularly the research project that I was concerned about. By participating in the faculty exchange program, I had the exciting chance of regularly interacting with researchers from the SCS and the HCII. [...] Throughout my stay at CMU, I attended seminars, talks, and classes at the Human-Computer Interaction Institute (HCII) and the SCS.[...] The quality of the weekly visitors was impressive, and I reckon it is one of the most significant benefits of being in such a big university. Furthermore, auditing classes enhanced my knowledge of the educational methods used at CMU and helped me understand their teaching strategies better. Therefore, I consider that the main goals of my visit to CMU were achieved and, additionally, it was possible to capture a holistic view of a distinguished university. I deem that this exchange semester contributed to strengthening the relationship between ITI/LARSyS and CMU, what most probably will translate into further research collaborations.”

**Bongkeum Jeong**
Researcher I ITI from LARSyS

**Host at CMU:** Jason Hong  
**Host Department:** HCI Institute (School of Computer Science)  
**Research Area:** Interactive technologies for HCI, issues of wearable computing, mobile computing, and context-aware computing.
The CMU Portugal Program has been designing two Advanced Training Programs: Data Science and Machine Learning; and Human-Computer Interaction. These initiatives will be offered by the Universidade de Lisboa (IST through Técnico+ and FCUL) and Universidade Nova de Lisboa (FCT-UNL) together with CMU and are expected to launch in the beginning of 2021. Several meetings were held between the partners to define the Program’s structure, content and budget. The CMU Portugal coordination office also met with multiple industry affiliates and other companies related to the areas of the Programs, and their inputs were crucial to define the structure of the Programs.

The Advanced Training Programs were designed in close collaboration with CMU, in terms of the structure of the programs, the modules that will be offered and their content. The objective of the training programs will be to provide professionals who work in ICT related areas a short and intensive educational program through which they will have close contact with the latest developments in their field of work but also cutting-edge methods and tools. The programs will encourage participants with a wide range of professional backgrounds and skills and will be an opportunity to share experiences with people from different areas: from software engineers, to data scientists to product managers. The faculty involved in the Programs will be composed of high-profile faculty from the participating universities but also of experts from industry.

As of 2019, both Programs already have the course structure defined, being that in 2020 the Program is working in the budget and final agreement to be signed by the parties so that the Programs can start in 2021.
The scientific output assessment of the CMU Portugal Program is of critical importance to understand the quality and impact of the research that is being produced by the Ph.D. students, Post-Doc researchers and faculty.

Looking into the more than 1,500 publications reported by the Program community since 2007 and made in the scope of the CMU Portugal Program, it is possible to identify two main tendencies. The first, of a steady growth in the total number of publications until 2013, and then a second tendency of a decrease in the number of publications to 2014, which have then remained relatively regular in their growth pattern. It is important to underline that the biggest differences in the number of publications produced per year were registered in years that followed the transition of one phase to another: from 230 publications to 101 from the 1st phase (2013) to the 2nd (2014), and from 136 to 90 from the 2nd phase (2018) to the 3rd (2019).

The graphic below shows the publications authored or co-authored in the scope of the CMU Portugal Program (2007-2019).
The number of active students decreasing until 2018 also explains this tendency, which will be discussed further in this chapter. Despite this decrease in the total number of publications, there has been an increase in the number of journal papers produced since 2015 (with the exception of 2017). In the period of 2018-2019 43 and 45 papers were produced respectively, which remains above the average of 40 journal papers produced per year since 2007. Regarding the books and book chapters that were produced, they have been in a tendency of relative growth since 2014, being that the books and book chapters produced in 2018 and 2019 (7 and 5 respectively) are on pair with the average of 5 since 2007. The decrease in the total number of publications corresponds with strong negative growth of the publications in conference proceedings which have, in the transition from the 1st phase to the 2nd phase, decreased from more than 100 per year to less than 100 per year, and then in the reporting period again decreased from 86 in 2018 to 40 in 2019.

From the more than 1,500 publications reported, 64% are conference papers, 32% journal papers and 4% books and book chapters.

When analyzing solely the publications authored or coauthored by dual degree Ph.D. students or alumni, one of the factors that had a higher contribution to the decrease in the total number of publications was the decrease in the number of active students, which led to a reduction in the number of publications authored or co-authored by Ph.D. students almost consistently since 2014 as it can be seen in more detail in the figure below. To note, the major discrepancies are most visible in the conference papers. Between 2018-2019 16 and 14 conference papers were produced respectively, below the average of 23 papers since 2007. Regarding the books and book chapter, from 2018-2019 2 books or book chapters were produced in 2018 and 0 in 2019. On the other hand, the journal papers present a steadier base of production. Between 2018-2019 8 journal papers were produced each year (but still below the average of 10 since 2007).
Considering the distribution of the publications authored or co-authored by Ph.D. students, which account for 438 publications, the majority of the publications (64%) were conference papers, followed by journal papers (28%), and books and book chapters (8%).

According to the Google Scholar website, used to analyze the impact of the publications: only 9% of the publications had 0 citations, 44% had from 1-10 citations, 40% had 11-100 citations and 7% had more than 100 citations. Analyzing the number of citations per year, strong growth was registered until 2015 which stabilized from 2016 onwards, maintaining the number of citations along the years despite, as we have seen before, a decrease in the number of publications produced.
Knowledge Creation
CMU Portugal supports research projects in the broad area of Information and Communication Technologies (ICT), with a particular focus on areas that have a direct impact on the data economy and foster interdisciplinary collaboration between industry and academia across different levels of the "big data" software stack. This includes research topics spanning from the technologies for processing large-scale data sets, to the artificial intelligence techniques that enable extracting value from data, or to the sociotechnical systems and applications that are catalyzed through these techniques.

Since 2006, the CMU Portugal Program has launched 9 calls and funded 72 projects.

2008 Call for Projects
Broad ICT and Computer Science area
- 10 Projects approved
- Concluded in 2012-2013

2009 Call for Projects
Broad ICT and Computer Science area
- 12 Projects approved
- Concluded in 2013-2014

2009 Joint Call for Projects with UT Austin
Partnership with UT Austin Portugal in Applied Mathematics
- 3 Projects approved
- Concluded in 2012-2013

2013 Call for Early Bird Projects
Jumpstart new high-impact initiatives with no emphasis on exploratory research
- 10 Projects approved
- Concluded in 2015-2016

2013 Call for Entrepreneurial Research Initiatives
Integrated activities in research, innovation, advanced education with industry collaboration for real world impact
- 6 Projects approved
- Concluded in 2018-2019

2014 Call for Entrepreneurial Research Initiatives
Integrated activities in research, innovation, advanced education with industry collaboration for real world impact
- 6 Projects approved
- 6 Projects still active in 2018-2019

2017 Call for Exploratory Research Projects
Identify emerging key strategic areas for a potential third phase
- 8 Projects approved
- Concluded in 2018-2019

2019 Call for Exploratory Research Projects
Jumpstart new high-impact initiatives emphasis on exploratory research
- 7 Projects approved
- Starting in 2020

2019 Call for Large-scale collaborative Projects
Led by national companies in partnership with non-corporate entities of the R&D System and Carnegie Mellon.
- 10 Projects approved
- Starting in 2020

In 2018 and 2019, 20 CMU Portugal Projects, 12 Entrepreneurial Research Initiatives (ERIs) and 8 Exploratory Projects (ERPs), were conducted across multiple Portuguese research institutions and CMU departments, strengthening the international collaborative effort across institutions and in close collaboration with industry partners. This commitment was further enhanced through the launch of two new calls for projects in 2019: a call for new Exploratory Research Projects and a call for Large-Scale Collaborative Research Projects. This last call represented the most significant public and private investment to date in research and technological development under the scope of the CMU Portugal Program with a total of 21 000 000 € of funding awarded. Together with the 2019 Exploratory Research Projects calls, which managed to award 820 000 € of funding, these two calls represented a total investment of 21 820 000 € of public and private funding in high quality and innovative research in ICT.
Entrepreneurial Research Initiatives (ERIs) are science, engineering, management and policy projects that jointly combine research, innovation and advanced training initiatives, in collaboration with companies, with an emphasis on the commercialization of technology with an economic and societal impact.

The projects have a maximum duration of 48 months and comprise a consortium of research teams from two Portuguese universities, one from Carnegie Mellon University and at least one partner company. The 2013 and 2014 competitive calls awarded 12 new grants with an overall funding of 10.8 M€ public funding and 2.6M€ financial commitment by private companies.

Entrepreneurial Research Initiatives

ERI 2013

An international innovation engine is a symbiotic relationship between researchers and industry partners, embedded in global knowledge and business networks, to create new ideas and translate them into products, processes, and services. Ultimately, ERIs seeks to foster a culture that integrates discovery, innovation, and internationalization by acting as international innovation and growth engines.

Furthermore, the projects strategically use professional master or doctoral education programs in Portuguese universities, including the dual degree programs of the CMU Portugal Program.
### ERI 2013 Call

<table>
<thead>
<tr>
<th>Project</th>
<th>Portuguese PI</th>
<th>Portuguese Institutions</th>
<th>CMU PI</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHA</td>
<td>Alexandre Bernardino (ISR-IST-ID; IST-UL)</td>
<td>IST-ID; FMH; M-ITI; NOVA.ID.FCT</td>
<td>Daniel P. Siewiorek (HCII); Asim Smailagic (HCII)</td>
<td>PLUX; YDreams Robotics</td>
</tr>
<tr>
<td>HYRAx</td>
<td>Fernando Silva (INESC TEC; FCUP)</td>
<td>INESC TEC; IT; NOVA.ID.FCT</td>
<td>Priya Narasimhan (CS/ECE)</td>
<td>Geolink; Wavecom; YinzCam</td>
</tr>
<tr>
<td>E4VALUE</td>
<td>Miguel Amaral (IN+; IST-UL)</td>
<td>IST-ID; IDMEC; INESC TEC</td>
<td>Granger Morgan (EPP)</td>
<td>CEIIA; Embraer Portugal</td>
</tr>
<tr>
<td>INSIDE</td>
<td>Francisco Melo (INESC ID; IST-UL)</td>
<td>INESC ID; IST-ID; NOVA.ID.FCT</td>
<td>Manuela Veloso (CS)</td>
<td>Hospital Garcia de Orta; IDMIND; PLUX; Voice Interaction</td>
</tr>
<tr>
<td>TEIPL</td>
<td>Pedro Oliveira (CLSBE/UCP)</td>
<td>CLSBE/UCP; IMM-FMUL; IST-UL</td>
<td>Lee Branstetter (SDS/Heinz)</td>
<td>INNOSABI; Microsoft; NOVARTIS</td>
</tr>
<tr>
<td>VR2MARKET</td>
<td>João Paulo Cunha (INESC TEC; FEUP)</td>
<td>INESC TEC; IT; UA</td>
<td>Fernando De la Torre (RI)</td>
<td>Biodevices; Future Cities-UPorto; Hospital de Gaia; Petratex</td>
</tr>
</tbody>
</table>

Knowledge Creation - Entrepreneurial Research Initiatives
## ERI 2014 Call

<table>
<thead>
<tr>
<th>Project</th>
<th>Portuguese PI</th>
<th>Portuguese Institutions</th>
<th>CMU PI</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ATLANTIC</td>
<td>Ramiro Neves (IST-UL)</td>
<td>IST-ID; ARDITI; M-ITI</td>
<td>H. Scott Mathews (EPP)</td>
<td>AM; CEIIA; EMAM; ISQ; ONIP; PETROGAL/Galp-E; R-Tech; TECHNIP; WAVEC</td>
</tr>
<tr>
<td>BioVisualSpeech</td>
<td>Sofia Cavaco (NOVA.ID.FCT; FCT/UNL)</td>
<td>NOVA.ID.FCT; INESC ID</td>
<td>Maxine Eskenazi (LTI)</td>
<td>CHLC; ESSA; HDE; SCML; Voice Interaction</td>
</tr>
<tr>
<td>GoLocal</td>
<td>João Magalhães (NOVA.ID.FCT; FCT/UNL)</td>
<td>NOVA.ID.FCT; INESC ID; IT</td>
<td>Jamie Callan (CS)</td>
<td>CML; Priberam; SAPO-LABS</td>
</tr>
<tr>
<td>S2MovingCity</td>
<td>Susana Sargento (IT/UA)</td>
<td>IT; UA</td>
<td>Manuela Veloso (CS)</td>
<td>APD; CMP; Veniam</td>
</tr>
<tr>
<td>SCREEN-DR</td>
<td>Aurélio Campilho (INESC TEC; FEUP)</td>
<td>INESC TEC; UA</td>
<td>Gustavo Rohde (BE)</td>
<td>ARSN; BMD; CHTS; First Solutions; HSJ; UPMC</td>
</tr>
<tr>
<td>STRETCHTRONICS</td>
<td>Aníbal Traça de Almeida (ISR-Coimbra; UC)</td>
<td>ISR-Coimbra; IPLEIRIA; UC</td>
<td>Carmel Majidi (ME)</td>
<td>CENTIMFE</td>
</tr>
</tbody>
</table>
Entrepreneurial Research Initiatives

By host CMU Departments and Portuguese Universities

12 ERIs

- Civil and Environmental Engineering
- Computer Science Department
- Electrical and Computer Engineering
- Engineering Accelerator
- Engineering and Public Policy
- Heinz
- Human-Computer Interaction Institute
- Language Technologies Institute
- Mathematical Sciences
- Robotics
- Social and Decision Sciences

CRACS
INESC TEC
IT Porto

IEETA
IT Aveiro
UAveiro

ISR-COIMBRA
Ucoimbra

IPLerlia

IST-ID
IN+
FMH
INESC ID
IDMEC
IMM-FMUL
IST
UNICEE
UCP
IT
ESSA/SCML

NOVA.ID.FCT
F-FCT/FCT/UNL

ARDITI
M-ITI
**Publications**

- **92** Prototypes
- **307** Peer-review conference papers
- **141** Peer-review papers
- **10** Patents
- **40** Ph.D. Thesis
- **159** Master Thesis

**Researchers funded by the Project**

- **25** Post Docs
- **45** Ph.D. (total)
- **17** Dual Ph.D. degrees
- **73** MSc
- **44** Other researchers

**Industrial partners**

- Action Modulera (AM)
- Administração Regional de Saúde do Norte (ARSN)
- AED Cluster Portugal – Aeronautics, Space and Defence
- Associação Porto Digital (APD)
- Biodevices, Sistemas de Engenharia Biomédica, S.A. (BioDevices)
- BMD Software (BMD)
- Bombeiros de Vila Real
- Bombeiros Voluntários de Albergaria-a-Velha
- Câmara Municipal de Lisboa (CML)
- Câmara Municipal do Porto (CMP)
- CEIIA – Centre of Engineering and Product Development
- Centro Hospitalar de Lisboa Central, EPE (CHLC)
- Centro para a Excelência e Inovação na Indústria Automóvel (CEIIA)
- Centro Tecnológico da Indústria de Moldes, Ferramentas Especiais e Plásticos (CENTIMFE)
- Embracer
- EMEPC, Estrutura de Missão para a Extensão da Plataforma Continental
- First Solutions
- Future Cities – Uporto
- Geolink
- Hospital de Gaia
- Hospital de São João (CHSJ)
- Hospital Dona Estefânia (HDE)
- Hospital Garcia de Orta, EPE (HGO)
- ICNF – Instituto de Conservação da Natureza e das Florestas
- IDMIND – Engenharia de Sistemas, Lda (IDMIND)
- IncidentAid Inc.
- innosabi GmbH (INNOSABI)
- Microsoft (MSFT)
- Instituto de Soldadura e Qualidade (ISQ)
- Organização Nacional da Indústria do Petróleo (ONIP)
- Lusotechnip Engenharia, Sociedade Unipessoal, Lda (TECHNIP)
- MR Terapias
- NAV, EPE
- Novartis Farma – Produtos Farmacêuticos S.A. (NOVARTIS)
- Petratex – Confecções SA
- Petróleos de Portugal – PETROGAL, SA (PETROGAL/Galp-E)
- Plux, Engenharia de Biosensores Lda (PLUX)
- PLUX, Wireless Biosignals, SA
- Priberam Informática, S.A. (Priberam)
- SAPO-LABS
- Steinbeis Advanced Risk Technologies (R-Tech)
- Veniam, Lda. (Veniam)
- Voice Interaction
- VoiceInteraction – Tecnologias de Processamento da Fala, S.A. (Voice Interaction)
- WAVEC/Offshore Renewables – Centro De Energia Offshore (WAVEC)
- Wavecom
- YDR, YDreams Robotics
- YinzCam

---

Knowledge Creation - Entrepreneurial Research Initiatives
The collaborations established through the Program’s 12 ERIs brought together industry, academic partners and people—faculty, researchers, industry experts, and students—in Portugal and at Carnegie Mellon. The networks established within these projects involved 26 Portuguese institutions and 46 companies across the country, and 11 CMU Departments (Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, the Engineering Accelerator, Engineering and Public Policy, Heinz, Human-Computer Interaction Institute, Language Technologies Institute, Mechanical Engineering, Social and Decision Sciences, and Robotics). People were at the center of these consortiums, with ERIs’ impact on the development of qualified human resources in Portugal and CMU. Overall, more than 310 researchers participated in the ERIs and 204 researchers were funded directly by the project: 25 post-doctoral fellows, 45 Ph.D. students—of which 17 were Dual-Degree Ph.D. students, 73 Master students and 44 other researchers. The collaborative projects can also be translated into their scientific achievements with 141 publications in international peer-review publications, 307 peer-review conference papers, 40 Ph.D. and 159 Master theses developed within the context of the ERIs.

In the area of innovation, the projects reported the development of 92 prototypes and the submission of 10 new patents. The information of each ERI, including summary and outputs, is compiled in the following section.

On March 25-26th, 2019, at FCT, Lisbon, the CMU Portugal Program organized mid-term and final project evaluations of the 12 approved projects: 5 final evaluations (projects that ended in November and December of 2018) and the assessments of 7 active projects. The independent international panel of experts was comprised by Alex Rogers (AR), University of Oxford; Giulio Sandini (GS), Istituto Italiano di Tecnologia; Manuel Gomez Rodriguez (MGR), Max Planck Institute for Software Systems; Marina van Geenhuizen (MvG), Delft University of Technology; Sergey Gorinsky (SG), IMDEA Networks Institute.

The final reports of the projects AHA, Hyrax, E4value, INSIDE, and TEIPL were all accepted by the evaluators and 4 out of the 5 projects were awarded the classification A (maximum) to 4 out of the 5 projects, i.e., “the projects scientific objectives have been fully achieved. The results show high scientific quality, including at the level of publications in international journals or other relevant indicators, and are widely accepted by the Scientific Community in the area where the project is integrated. The projects contributed to the training of young researchers and the international projection of the teams involved.”

Overall, the committee praised the scientific and technological impact of the projects.

“The project appears to be performing world leading research in the area of stretchable electronics. The work has been published at top international conferences and in top-tier journals. It has resulted in a patent application describing both a new material and a new fabrication process, and a spin-out, which already appears to be active exploiting aspects of this technology.”

“The scientific output of the project is impressive. There have been a number of deployments of the system with real end-users to fully evaluate it, and these evaluations, along with contributions involving the necessary signal processing to detect stress from biological measurements, have been published in a large number of peer reviewed venues, including international conferences (including UbiComp and MOBIQUITOUS) and top tier journals.”

“The quality of the scientific research is excellent. They have made significant progress on developing a platform for automatic diabetic retinopathy (DR) screening by creating highly valuable annotated datasets and leveraging state of the art machine learning techniques. It is encouraging that a version of the platform is already in production and they have published an impressive number of peer-reviewed publications (journal paper and conference papers)”
The ultimate goal of the +Atlantic project is to promote a consortium in the form of an International Observatory, to stimulate participatory risk governance activities, to support the design of public policies and the sustainable development of industry, so as to foster the endogenous development of Atlantic regions. It is particularly aimed to help improving our understanding of new innovation dynamics and technology-based services for offshore sustainable industries over the Atlantic.

The project was planned as an initial step for a large cross Atlantic initiative, connecting the north and the south, fostering the collaboration between industry and academy. Oil&Gas growth new needs of this industry along a chain of different technological and scientific suppliers was foreseen as major driving force for the project, but during project implementation marine energies and aquaculture together with the north-south link became the focus of the project.

Techno-economical and Environmental analysis assessment of marine energies, aquaculture offshore Oil&Gas and Deep Sea Mining and supporting technologies (modeling, monitoring and robotics) for spatial planning and exploitation where developed, including a climatological atlas, a monitoring buoy and a IT tool to manage robotics data and a platform to support regional ocean observatories.

Keywords
- Communication Platform
- Advanced technologies for inspection and maintenance of subsea systems
- 3D forecast models

Website:
https://maisatlantico.com
Research institutions

- Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação (ARDITI)
- Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
- Carnegie Mellon University (CMU)
- Madeira Interactive Technologies Institute (M-ITI)

Industry Partners

- Action Modulers (AM)
- Centro para a Excelência e Inovação na Indústria Automóvel (CEIIA)
- Instituto de Soldadura e Qualidade (ISO); Organização Nacional da Indústria do Petróleo (ONIP)
- Wavec/Offshore Renewables – Centro De Energia Offshore (WAVEC)

The main project stakeholders were:

- Petrólêos de Portugal – PETROGAL, SA (PETROGAL/Galp-E)
- Lusotechnip Engenharia, Sociedade Unipessoal, Lda (TECHNIP)
- EMEPC, Estrutura de Missão para a Extensão da Plataforma Continental,
- Steinbeis Advanced Risk Technologies (R-Tech)

Researchers funded by the Project

- 4 Post Docs
- 4 Ph.D. (total)

Prototypes

- 2

Publications

- 9 Peer-review papers
- 4 Peer-review conference papers
- 3 Ph.D. Thesis

Selected publications


https://doi.org/10.1016/j.ecolmodel.2017.04.018


https://doi.org/10.5194/os-13-673-2017


https://doi.org/10.1016/B978-0-12-409548-9.11614-8
AHA – Augmented Human Assistance

Start: 01/08/2014
End: 31/12/2018

Aging and sedentarism are two main challenges for social and health systems in modern societies. To face these challenges a new generation of ICT based solutions is being developed to promote active aging, prevent sedentarism and find new tools to support the large populations of patients that suffer chronic conditions as result of aging. We highlight the development of a set of exergames specifically designed for sedentary prevention and motor rehabilitation, customizable to the motor limitations of each individual, projected in the environment through augmented reality techniques that create an immersive and engaging experience. Virtual and Robot coach techniques are able to monitor the correctness of the exercise, give immediate feedback to the user, and complement the role of the therapist. We have performed several end-user studies that validate the proposed approaches. Together, or in isolation, these solutions provide users, caregivers, health professionals and institutions, valuable tools for health promotion, disease monitoring and prevention.

Principal Investigators

Alexandre Bernardino
IST, ISR | Lisboa

Daniel P. Siewiorek
CMU, HCII

Asim Smailagic
CMU, ICES

Keywords
- Active Aging
- Assistive Robotics
- Augmented Reality

Website:
aha.isr.tecnico.ulisboa.pt
Research institutions

- Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
- Carnegie Mellon University (CMU)
- Fundação da Faculdade de Ciência e Tecnologia da Universidade NOVA de Lisboa (F-FCT/FCT/UNL)
- Faculdade de Motricidade Humana, Universidade de Lisboa (FMH)
- Madeira Interactive Technologies Institute (M-ITI)

Industry Partners

- PLUX, Wireless Biosignals, SA
- YDR, YDreams Robotics

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Post Docs</th>
<th>Ph.D. (total)</th>
<th>Dual Ph.D. degrees</th>
<th>MSc</th>
<th>Other researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Prototypes

<table>
<thead>
<tr>
<th>Prototypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Patents

<table>
<thead>
<tr>
<th>Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Publications

<table>
<thead>
<tr>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 Peer-review papers</td>
</tr>
<tr>
<td>45 Peer-review conference papers</td>
</tr>
<tr>
<td>2 Ph.D. Thesis</td>
</tr>
<tr>
<td>17 Master Thesis</td>
</tr>
</tbody>
</table>

Selected publications

Muñoz J., Gonçalves A., Gouveia E., Cameirão M., Bermúdez i Badia Sergi. (2019) "Lessons Learned from Gamifying Functional Fitness Training Through Human-Centered Design Methods in Older Adults". Games for Health Journal. Volume 8, 387-406. [https://doi.org/10.1089/g4h.2018.0028](https://doi.org/10.1089/g4h.2018.0028)


BioVisualSpeech

Start: 01/04/2016
End: 31/03/2021

BioVisualSpeech, proposes to research natural and multimodal human computer interaction mechanisms for providing bio-feedback in speech and language therapy through the use of serious digital games. To this end we have been developing tools for speech and language therapy that combine visual feedback and the gamification of the speech-language therapy exercises. Several serious games have been developed along with tools assist the speech and language pathologist (SLP) in examining the patient progress and characterize the patient disorder. The developed games include games for voice disorders and for sigmatism that are already available to the public. All the work has been assessed by SLPs and has been the result from the collaboration between computer scientists and SLPs.

Principal Investigators

Sofia Cavaco
FCT/UNL; NOVA.ID.FCT

Maxine Eskenazi
CMU, LTI

Keywords
- Speech therapy
- Visual feedback
- Serious games

Website:
novasearch.org/biovisualspeech
Research institutions

- Associação para a Inovação e Desenvolvimento da FCT (NOVA.ID.FCT)
- Carnegie Mellon University (CMU)
- Escola Superior de Saúde de Alcoitão (ESSA) - Santa Casa da Misericórdia de Lisboa (SCML)
- Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa (INESC ID)

Industry Partners

- Voice Interaction

Industry collaborators (not formal project partners)
MR Terapias

Other partners
Hospital Dona Estefânia (HDE) - Centro Hospitalar de Lisboa Central, EPE (CHLC)

Researchers funded by the Project

- 3 Ph.D. (total)
- 1 Dual Ph.D. degrees
- 3 MSc
- 7 Other researchers

Prototypes

- 3

Publications

- 1 Peer-review papers
- 20 Peer-review conference papers
- 1 Ph.D. Thesis
- 11 Master Thesis

Selected publications


E4Value assesses technology, businesses and value chains in aeronautics. The project sheds a new light on the aeronautics industry in Portugal, unveiling the role played by key actors, existent capabilities, barriers and opportunities for building a resilient cluster. Throughout the project we: (i) conducted dozens of interviews and ‘in situ’ visits; (ii) trained several MSc and Ph.D. national and international students; (iii) published many research papers in renowned journals; (iv) attended several scientific meetings and conferences; (v) involved multinational research teams and specialists across the globe; (vi) organized multiple practical workshops and initiatives with companies and (vii) strengthened the network on Industrial Dynamics and Systems of Engineering research between Portugal and USA (CMU) as well as with other international partners. Companies, research institutions and decision-makers benefited from the networking and research outputs promoted by the project.

Keywords
- Aeronautics
- Industrial Cluster
- Technological Change

Website:
www.e4value.net
Researchers funded by the Project

5 Post Docs
5 Ph.D. (total)
2 Dual Ph.D. degrees
3 MSc

Publications
8 Peer-review papers
4 Peer-review conference papers
4 Ph.D. Thesis
2 Master Thesis

Selected publications


Each tourist stays in Lisbon 2 to 2.5 days, which is a very short window of opportunity for recommending one of the many attractions or cultural events. GoLocal proposes to advance big data technology in the development of new information businesses and services. Our long-term vision aims at making big data economically useful by realizing the full potential of big data analysis technologies in the design of innovative services for the end-consumer.

Tourism data can be used to recommend a full-day of tourist activities, to detect the right consumer for a given promotion, or to monitor a brand reputation. In this context, the project will target two technological goals. First, we will investigate media monitoring technology to track the popularity or reputation of entities on the Web. Knowing the right market value of a brand or a product is a valuable information with many uses. The second technological objective concerns context-aware recommendation. We propose to innovate in this area by investigating new ways of inferring clues from the user context and by compiling a set of items to recommend to groups of users.
Research institutions

- Associação para a Inovação e Desenvolvimento da FCT (NOVA.ID.FCT)
- Carnegie Mellon University (CMU)
- Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa (INESC ID)
- Instituto de Telecomunicações (IT)

Industry Partners

- Câmara Municipal de Lisboa (CML)
- Priberam Informática, S.A. (Priberam)
- SAPO-LABS

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Ph.D. (total)</th>
<th>Dual Ph.D. degrees</th>
<th>MSc</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Prototypes

- 2

Publications

- 4 Peer-review papers
- 25 Peer-review conference papers
- 3 Ph.D. Thesis
- 3 Master Thesis

Selected publications


HYRAX is a middleware that establishes communication links between nearby mobile devices to form edge-clouds and cloudlets networks. HYRAX provides mechanisms for network formation and routing, that are automated, churn-tolerant and employs different wireless communication technologies simultaneously, forming an overlay network for data dissemination.

The societal impact of the Hyrax project is significant as we have demonstrated prototypes that unambiguously prove the usefulness of edge-clouds for real world problems. We highlight three examples. One of the prototypes uses device-to-device communication to stream multimedia contents relieving the WiFi infrastructures in stadiums, congress halls and other venues from bandwidth bottlenecks while providing better QoS. Another prototype uses devices deployed in a disaster area to opportunistically gather the intelligence required for planning the establishment of rescue teams by exchanging geo-referenced, time-stamped video, audio, photos and text notes. The crowd-sourced information can then be used to automatically generate reports to be analyzed at headquarters. Finally, another prototype implements distributed face-recognition algorithms that could allow a missing person to be located in a crowded area by taking advantage of photos from the devices of passers by.
Research institutions

- Associação para a Inovação e Desenvolvimento da FCT (NOVA.ID.FCT)
- Carnegie Mellon University (CMU)
- Center for Research in Advanced Computing Systems (CRACS)
- Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)
- Instituto de Telecomunicações (IT)

Industry Partners

- Geolink
- Wavecom
- YinzCam

Researchers funded by the Project

- 2 Post Docs
- 3 Ph.D. (total)
- 2 Dual Ph.D. degrees
- 16 MSc
- 1 Other researchers

Publications

- 2 Peer-review papers
- 41 Peer-review conference papers
- 7 Ph.D. Thesis
- 16 Master Thesis

Selected publications


The INSIDE initiative explored both scientific and technological challenges involved in developing symbiotic multimodal human-robot interactions in the context of a physical game involving children. INSIDE contributed a number of scientific advances in human robot interaction, exploring the idea of symbiotic interaction, multi-modal interaction and the impact of technology on therapy, leading to over 10 journal publications and almost 100 conference and workshop papers. INSIDE also supported the deployment of a robotic “therapy assistant” that was tested in actual therapy sessions with children with Autism Spectrum Disorders in Hospital Garcia de Orta.

Keywords
- Human-robot Interaction
- Symbiotic Interaction
- Multiagent Planning

Website:
http://www.project-inside.pt
Research institutions

- Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
- Associação para a Inovação e Desenvolvimento da FCT (NOVA.ID.FCT)
- Carnegie Mellon University (CMU)
- Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa (INESC ID)
- Hospital Garcia de Orta, EPE (HGO)
- IDMIND – Engenharia de Sistemas, Lda (IDMIND)
- Plux, Engenharia de Biosensores Lda (PLUX)
- VoiceInteraction – Tecnologias de Processamento da Fala, S.A. (Voice Interaction)

Industry Partners

- Researchers funded by the Project
- 3 Post Docs
- 2 Ph.D. (total)
- 2 Dual Ph.D. degrees
- 15 Other researchers

- Prototypes
- 7

- Publications
- 13 Peer-review papers
- 44 Peer-review conference papers
- 6 Ph.D. Thesis
- 13 Master Thesis

Selected publications


The S2MovingCity is making use of a unique vehicular and sensing infrastructure to focus on providing the city of Porto with a more “effective” solution to support planning and city-wide management to improve the city comfort on city dwellers (transportation, people and institutions). This project has been delivering new knowledge and a proof of concept for massive urban sensing of people, vehicles, and environment, supporting data-driven city planning and decision making. The resulting knowledge and technologies of the project are improving the city environment and adapting the city planning and transportation according to its demands. In terms of innovation and product, this project will culminate in 3 innovations:

1) Improve a vehicular network equipment through the integration with sensors, development of delay tolerant protocols, network coding and security;
2) Decision dashboards for the decision support and prediction (tools for city planning);
3) Mobile applications for smart-cities and city participation, including 3rd party companies and users, which will have wide access to the anonymized information.

Principal Investigators

Susana Sargento
IT/UA

Manuela Veloso
CMU, CS

Peter Steenkiste
CMU, ECE

Keywords

- Smart Moving City
- Sense and Serve the City
- Vehicular and Sensing Network

Website:
www.s2movingcity.av.it.pt
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Telecomunicações Aveiro (IT Aveiro/IT)
- Universidade de Aveiro (UA)

Industry Partners

- Associação Porto Digital (APD)
- Câmara Municipal do Porto (CMP)
- Veniam, Lda. (Veniam)

Researchers funded by the Project

4 Post Docs
5 Ph.D. (total)
1 Dual Ph.D. degrees
6 MSc
7 Other researchers

Prototypes 17 Patents 3

Publications

26 Peer-review papers
58 Peer-review conference papers
3 Ph.D. Thesis
31 Master Thesis

Selected publications


SCREEN-DR

Start: 01/04/2016
End: 30/09/2020

The North of Portugal Health Administration is implementing a mass screening for diabetic retinopathy (DR). The goal is to perform an eye exam on about 75% of identified diabetics. The goal of the SCREEN-DR consortium is to create a distributed and automatic screening platform for DR, based on PACS management, Machine Learning and Image Analysis, enabling an immediate response from health carers, allowing accurate follow-up strategies, and fostering technological innovation. The main objectives are: automatically assessing image quality, automatically detecting and grading diabetic retinopathy, which can be mild non proliferative, moderate/severe non-proliferative and proliferative. The results achieved so far are very promising with a performance close to the medical experts, in particular for the automatic detection of DR. This may have a large positive impact on population healthcare and can reduce drastically the work load of the ophthalmologist in the screening process.

Principal Investigators

Aurélio Campilho
INESC TEC, FEUP

Asim Smailagic
CMU, ICES

Keywords

- Computer-aided diagnosis
- Collaborative PACS-Cloud
- Diabetic retinopathy screening

Website:
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)
- Universidade de Aveiro (UA)

Industry Partners

- Administração Regional de Saúde do Norte (ARSN)
- BMD Software (BMD)
- First Solutions
- Hospital de São João (CHSJ)

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Post Docs</th>
<th>Ph.D. (total)</th>
<th>Dual Ph.D. degrees</th>
<th>Other researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Prototypes 9

Patents 1

(in preparation)

Publications

10 Peer-review papers 27 Peer-review conference papers 16 Master Thesis

Selected publications


Stretchtronic has focused on methods for scalable fabrication of thin-film stretchable electronics, including various printing techniques. It also demonstrated the application of these systems in pressure sensing films, electronic skins for robotics, and health monitoring electronic tattoos. Also, application of the system was demonstrated in novel forms of HMI in hybrid devices that combine 3D printed forms and electronic interfaces. Such efforts resulted in a joint patent application between ISR, UC, and CMU, and numerous publications in high impact factor journals such as Advanced Materials, Advanced Healthcare Materials, and ACS Applied Materials and Interfaces, and was reported by various scientific portals and news agencies, including Reuters, and American Society of Chemistry Headline Science. The team expects important socio-economic impacts in the healthcare, and advanced manufacturing sectors.
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Sistemas e Robótica (ISR-COIMBRA)
- Instituto Politécnico de Leiria (IPLEIRIA)
- Universidade de Coimbra (UC)

Industry Partners

- Centro Tecnológico da Indústria de Moldes, Ferramentas Especiais e Plásticos (CENTIMFE)
- SoftBionics

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Post Docs</th>
<th>Ph.D. (total)</th>
<th>Dual Ph.D. degrees</th>
<th>MSc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
</tbody>
</table>

Prototypes 8

Patents 1

Publications

- 16 Peer-review papers
- 5 Peer-review conference papers
- 1 Ph.D. Thesis
- 19 Master Thesis

Selected publications


TEIPL is a multidisciplinary organization, bringing together leading academic and corporate partners that aims to create a world class research and policy center that investigates technological innovation by both users and producers to transform healthcare by optimizing resource allocation, reducing costs, improving diagnoses and enabling novel therapies. Patient Innovation, an outcome of the project, is an online platform where patients and caregivers around the world connect to share and create solutions they developed themselves or had the help from collaborators to cope with a health-related problem.

**Keywords**
- User Innovation
- Innovation Policy
- Innovation in the Health-care Sector

**Website:**
[www.patient-innovation.com](http://www.patient-innovation.com)
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Medicina Molecular (IMM-FMUL)
- Instituto Superior Técnico (IST)
- Universidade Católica Portuguesa (UCP)
- Unidade de Investigação em Ciências Económicas e Empresariais (UNICEE)

Industry Partners

- innosabi GmbH (INNOSABI) Microsoft (MSFT)
- Novartis Farma – Produtos Farmacêuticos S.A. (NOVARTIS)

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Ph.D.</td>
<td>2</td>
</tr>
<tr>
<td>MSc</td>
<td>6</td>
</tr>
</tbody>
</table>

Publications

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer-review papers</td>
<td>17</td>
</tr>
<tr>
<td>Ph.D. Thesis</td>
<td>3</td>
</tr>
<tr>
<td>Master Thesis</td>
<td>6</td>
</tr>
</tbody>
</table>

Selected publications


VR2Market

**Start:** 15/07/2014  
**End:** 30/06/2019

VR2Market explored the synergies between innovative wearable technologies, scattered sensor networks and localization to provide more secure, reliable and effective health and wellbeing management solutions. VR2Market was able to develop a novel wearable quantified Occupational Health (qOH) platform devoted to monitor first responder’s health status, geo-location and body-area ambient parameters, providing reliable first-response information in emergency scenarios’ management. This solution has unique and distinctiveness functionalities, in terms of innovative user profiling, intelligent alerting and self-monitoring services and is totally scalable to other occupational groups. The system was tested in several scenarios and more than 1500hrs of real world data were collected. VR2 Market also achieved an excellent scientific impact publishing in renowned journals, top conferences, and also submitted three patents. The devoted collaboration of the team was of high importance to reach the project indicators.

**Keywords**
- Wearable technologies
- Quantified Occupational health
- First responders

**Website:**
http://vitalresponder.inesctec.pt
**Research institutions**

- Carnegie Mellon University
- Institute of Electronics and Telematics Engineering of Aveiro (IEETA)
- Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)
- Instituto de Telecomunicações (IT)
- Universidade de Aveiro (UA)

**Industry Partners**

- Biodevices, Sistemas de Engenharia Biomédica, S.A. (BioDevices)
- Future Cities – Uporto
- Hospital de Gaia
- Petratex – Confecções SA
- IncidentAid inc.
- NAV, EPE
- Bombeiros Voluntários de Albergaria-a-Velha
- Bombeiros de Vila Real
- ICNF – Instituto de Conservação da Natureza e das Florestas

---

**Researchers funded by the Project**

<table>
<thead>
<tr>
<th>Post Docs</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. (total)</td>
<td>5</td>
</tr>
<tr>
<td>Dual Ph.D. degrees</td>
<td>2</td>
</tr>
<tr>
<td>MSc</td>
<td>10</td>
</tr>
<tr>
<td>Other researchers</td>
<td>3</td>
</tr>
</tbody>
</table>

**Prototypes**

- 18

**Patents**

- 3

**Publications**

- Peer-review papers: 18
- Peer-review conference papers: 34
- Ph.D. Thesis: 7
- Master Thesis: 25

**Selected publications**


**Exploratory Research Projects** (ERPs) encourage new initiatives, with high impact potential, with the primary objective of promoting Portugal’s international competitiveness and innovation capacity in Science and Technology (S&T) in strategic ICT emerging areas of interest to the CMU Portugal Program. ERPs are selected through Exploratory Research project Calls, funded by the Fundação para a Ciência e a Tecnologia (FCT) for 12 (twelve) months. In 2014, the Early Bird Projects Call awarded the first 10 exploratory projects. This initial call was followed by two new calls for ERPs in 2017 and 2019.

**Exploratory Research Projects 2017**

The main objective of the 2017 call for Exploratory Projects was to identify and assess strategic areas for the third phase of the CMU Portugal Program. Therefore, the call addressed initiatives with high impact potential in 6 strategic emerging areas: Integrative research based in the context of the AIR Center, Data Science and Engineering, Computer Science, Electrical and Computer Engineering, Applied Mathematics and Technology, Management, and Policy. With an overall commitment of 1,430,000 € to support resources and activities in Portuguese research institutions and complementary activities at Carnegie Mellon University, the call awarded funding for 8 new projects, out of 21 proposals, that were developed in 2018 and 2019. All the 8 projects have reached their conclusion within the expected timeline (2018-2019).
## ERPs 2017

<table>
<thead>
<tr>
<th>Project</th>
<th>Portuguese PI</th>
<th>CMU PI</th>
<th>Portuguese Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conquest</td>
<td>Fernando Velez (IT, UBI)</td>
<td>John Peha (ECE)</td>
<td>IT; UBI; UC</td>
</tr>
<tr>
<td>DoubleChain</td>
<td>Pedro Sanches Amorim (FEUP)</td>
<td>Nicolas Christian (CS)</td>
<td>FEUP; INESC TEC</td>
</tr>
<tr>
<td>FeedBot</td>
<td>Manuel Marques (IST – ID)</td>
<td>Manuela Veloso (CS)</td>
<td>IST-ID; MITI</td>
</tr>
<tr>
<td>DeepData</td>
<td>Inês Lynce (INESC-ID)</td>
<td>Ruben Martins (CS)</td>
<td>INESC ID; IMAR</td>
</tr>
<tr>
<td>THz</td>
<td>Kazi Huq (IT Aveiro)</td>
<td>Douglas Sicker (EPP)</td>
<td>IT Aveiro; UA</td>
</tr>
<tr>
<td>eCSAAP</td>
<td>Hugo Paredes (INESC TEC; UTAD)</td>
<td>Jeffrey Bigham (CS)</td>
<td>INESC TEC; UTAD; IDL; Fciências.ID</td>
</tr>
<tr>
<td>PoliTechWaste</td>
<td>Paulo de Brito (IPPortalegre)</td>
<td>Inês Azevedo (SEEES)</td>
<td>IPPortalegre; UA</td>
</tr>
<tr>
<td>Privacy Preserving Middleware Platform for IoT</td>
<td>Luis Antunes (FCUP)</td>
<td></td>
<td>FCUP; UA; APD</td>
</tr>
</tbody>
</table>
The ERPs promoted research networks across 15 Portuguese institutions across the country, and 4 CMU Departments (Center on Sustainable, Equitable, Efficient Energy Services: Computer Science; Electrical and Computer Engineering; Engineering and Public Policy). ERPs supported 33 researchers during their 12-month duration: 2 postdoctoral fellows, 12 Ph.D. students, 13 master students, and 6 other researchers. The ERP exploratory character, enabled researchers to sow the seeds for future projects, and their innovative nature was reflected on the development of 4 new prototypes. Although their outputs were expected to go beyond the publication of articles and other metrics, the researchers published 16 articles in international peer-review publications, 43 peer-review conference papers and 11 Master theses were developed within the context of the ERPs.

<table>
<thead>
<tr>
<th>Publications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototypes</td>
<td>16 Peer-review papers</td>
</tr>
<tr>
<td>Peer-review conference papers</td>
<td>11 Master Thesis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Researchers funded by the Project</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Docs</td>
<td>2</td>
</tr>
<tr>
<td>Ph.D. (total)</td>
<td>12</td>
</tr>
<tr>
<td>MSc</td>
<td>13</td>
</tr>
<tr>
<td>Other researchers</td>
<td>6</td>
</tr>
</tbody>
</table>
Exploratory Research Projects 2017

By CMU Departments and Portuguese institutions (proponent or participant)

- Computer Science Department: 4 participants
- Engineering and Public Policy: 1 participant
- Electrical and Computer Engineering: 2 participants
- SEEES: 1 participant
- UTAD: 1 participant
- APD: 4 participants
- FCUP: 4 participants
- FE/UP: 4 participants
- INESC TEC: 4 participants
- IT-Aveiro: 1 participant
- UAveiro: 1 participant
- UCoimbra: 1 participant
- IPPortalegre: 4 participants
- MITI: 1 participant

15 Participants
Mobile network operators need new approaches to keep up with traffic, which is doubling roughly every 1.5 years. These new approaches bring new challenges. Conquest – Carrier Aggregation between Licensed Exclusive and Licensed Shared Access Frequency Bands in Heterogeneous Networks with Small Cells – has explored allowing mobile devices to use multiple spectrum bands at once (carrier aggregation), using multiple cellular infrastructures at once (multi-network access), using small cells, and using spectrum at higher frequencies than was previously cost-effective (millimeter wave bands). It has developed new approaches to assessing the capacity of small cells at high frequencies, and thus designing microcellular networks. It finds that the distinct propagation characteristics of millimeter-wave spectrum lead to unexpected capacity levels when cells become small. This work has also shown that much greater capacities can be achieved with no increase in infrastructure costs or spectrum holdings through multi-network access, provided that the towers of different mobile network operators are not co-located. PDMFC is interested in the technology (we started a MSCA ITN “TeamUp5G” with this Portuguese SME).
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Telecomunicações (IT) (UBI)
- Universidade de Coimbra (UC)

Researchers funded by the Project

<table>
<thead>
<tr>
<th>Ph.D (total)</th>
<th>MSc</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Prototypes

1

Publications

4 Peer-review papers 2 Books 13 Peer-review conference papers 2 Master Thesis

Selected publications


The DeepData project launched a concrete research challenge: To develop the theory, the algorithms and the tools to make automatic data analysis and predictive species distribution modeling both accurate and efficient. The goal of the DeepData project is therefore to advance the state of the art in the exploitation of data referring to Azores’ deep sea. This project delivered DeepData, a tool containing a web-based database of deep-sea species that automatically extracts information from existing databases or from user-defined databases. This information is used by the DeepData tool to estimate species distribution models for deep-sea species by using different statistical models. To facilitate the integration of new data, we also developed SQUARES, a program synthesis tool based on input-output examples that can automatically extract and transform data using SQL queries and R scripts.

Website: sat.inesc-id.pt/deepdata

Keywords
- Data Science
- Automated Reasoning
- Deep Sea

Principal Investigators

Inês Lynce  
INESC-ID

Ruben Martins  
CMU

Telmo Morato  
IMAR
**Research institutions**

- Carnegie Mellon University (CMU)
- Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento (INESC ID)
- IMAR – Instituto do Mar (IMAR)

**Researchers funded by the Project**

<table>
<thead>
<tr>
<th>Ph.D</th>
<th>MSc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>(total)</td>
<td></td>
</tr>
</tbody>
</table>

**Prototypes**

2

**Publications**

<table>
<thead>
<tr>
<th>Peer-review papers</th>
<th>Peer-review conference papers</th>
<th>Master Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**Selected publications**


In markets with highly concentrated firms, consumers are often subject to excessive prices, and lack the tools to tilt the balance in their favour. The Doublechain project intended to study the applicability of Blockchain technology to address this issue, by creating a marketplace that helps consumers to coordinate and engage in syndicated buying. The approach deviated significantly from typical group buying websites since orders could be initiated by consumers and suppliers enter reversed auctions to bargain on the price to close the deal. As transactions of this type carry some risks, decentralized technologies were used to create a governance network that provides well-defined rules and privacy-preserving distributed data governance, bringing a human-centric solution to society. A successful prototype was built, allowing stakeholders to close an aggregate purchase deal - http://briing.io. A scientific article was also submitted to IEEE Transactions on Engineering Management.
### Research institutions

- Carnegie Mellon University (CMU)
- Faculdade de Engenharia da Universidade do Porto (FEUP)
- INESC Tecnologia e Ciência (INESC TEC)

### Researchers funded by the Project

<table>
<thead>
<tr>
<th>Role</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Docs</td>
<td>2</td>
</tr>
<tr>
<td>Other researchers</td>
<td>3</td>
</tr>
</tbody>
</table>

### Prototypes

- 1

### Publications

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer-review papers</td>
<td>1</td>
</tr>
<tr>
<td>Master Thesis</td>
<td>1</td>
</tr>
</tbody>
</table>

### Selected publications

Fostering consumer bargaining and e-procurement through a decentralized marketplace on the blockchain – Manuscript ID: TEM-19-0522.R1 (under re-evaluation after minor review)

eCSAAP project aims to explore the application of crowdsourcing in climate and climate change research, through expert crowd annotation of atmospheric phenomena. Atmospheric phenomena annotation aims to bring new dimensions to current big data problems in climate and atmospheric sciences, so automated methods and computational resources can be optimized in a future hybrid approach.

The project developed a set of modular tools, available online that allow the acquisition, processing and visualization of climatic data available in open databases, in several formats. The tools are available through the eCSAAP platform, which has been integrated with crowdsourcing tools for the data semantic annotation. The integration process was enhanced by developing an ontology for extreme atmospheric phenomena that was used for the generation of crowdsourcing task templates.

The instruments developed have been used to study the behavior of specialists in the atmospheric data annotation process. These studies will allow advances in state of the art of the influence of pre-existing annotations on the behavior of specialists, as well as the potential for developing collective intelligence through these mechanisms.

**Keywords**
- Crowdsourcing
- Climate change
- Semantic annotation

**Website:** reality.utad.net/ecsaap

---

**Principal Investigators**

Hugo Silva
INESC TEC

Jeffrey Bigham
CMU, CS

Margarida Liberato
IDL/Fciências.ID
Research institutions

- Carnegie Mellon University (CMU)
- Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)
- Instituto Dom Luiz (IDL)/Associação para a Investigação e Desenvolvimento de Ciências (Fciências.ID)

Selected publications


In Feedbot project, we developed a low-cost autonomous robot for meal assistance to motion-impaired people. The mobile arm is capable of reaching a specific destination in 3D space, as tasked by a vision system, and can adapt to the movements of each individual. We also developed a new framework to learn and classify different head movements. With its autonomy and learning, we foresee that FeedBot will have a great impact in the quality of life of people with a wide range of motion-related disorders, such as Parkinson’s disease, cerebral palsy or stroke.
**Research institutions**

- Carnegie Mellon University (CMU)
- Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
- MITI – Madeira Interactive Technologies Institute Associação (MITI)

**Researchers funded by the Project**

<table>
<thead>
<tr>
<th>MSc</th>
<th>Other researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Prototypes**

1

**Publications**

3 Peer-review conference papers
3 Master Thesis

**Selected publications**


The main goal of this project was to understand the viability of using MSW and biomass blends to produce cheaper and high-quality syngas for energy purposes (complementary solution to current grid infrastructure), as well as to understand the environmental, health and climate change consequences of this technology use.

It was demonstrated that it is possible the co-gasification of Solid Waste (processed as Refused Derived Fuel-RDF) with biomass in a pilot-scale fluidized bed reactor (75kWth), producing a raw gas with suitable characteristics to be used as energy vector for further applications.

The economic models applied to the gasification of residual biomass and municipal solid waste presented a positive prospect admitting the viability of setting the conceived projects in the determined regions under current market conditions. Residual biomass and MSW used in this project usually have low valorization, being mostly deposited in landfills. In this sense, the demonstration of the viability of converting these wastes into syngas promotes the idea of their recovery, which constitutes an economic opportunity for value creation, and represents a fundamental issue in the framework of waste management in the circular economy concept.
Researchers funded by the Project

- 4 Ph.D (total)
- 3 MSc
- 1 Other researchers

Publications

- 2 Peer-review papers
- 3 Peer-review conference papers
- 1 Master Thesis

Selected publications

https://doi.org/10.32438/WPE.7719
THz seems to be the key to providing the orders of magnitude of gain required to meet the challenge of this project which will provide the springboard ready to embark on his 5G legacy and beyond. The primary focus of this project is to identify key use cases and frequency bands for THz-based mobile communications; develop new Generalized Hybrid Beamforming for Vehicular Connectivity using THz Massive MIMO and study the impact of 3D channel modeling for ultra-high speed B5G networks that take into account spatial coupling by re-examining legacy engineering tools such as mobility modeling through interdisciplinary design. Moving toward making THz a reality for broadband communication, this project address a few essential issues. These are:

- Terahertz Massive MIMO for Beyond-5G Wireless Communication.
- Generalized Hybrid Beamforming for Vehicular Connectivity using THz Massive MIMO.
- Parameter Modeling for Small-Scale Mobility in Indoor THz Communication.
- Mobility-induced Outages in THz—A Beyond 5G (B5G) application.
- An Analytical Model for Efficient Indoor THz Access Point Deployment.

**Principal Investigators**

Kazi Mohammed Saidul Huq  
IT,UA

Douglas Sicker  
CMU, EPP

**Keywords**

- 5G
- Mobility
- THz

**Website:**  
http://briing.io
Researchers funded by the Project

2 Ph.D (total)
2 MSc

Publications

4 Peer-review papers
8 Peer-review conference papers
1 Ph.D. Thesis

Selected publications

https://doi.org/10.1109/MNET.2019.1800430

https://doi.org/10.1109/TVT.2019.2921563

https://doi.org/10.1109/GLOBECOM38437.2019.9013838
A new call for ERPs was launched in 2019 to assist teams of researchers from Portuguese institutions, Carnegie Mellon University, and industry partners, to bootstrap high-impact potential research activities of strategic relevance for the CMU Portugal Program.

The CMU Portugal Program supported under the 2019 call, 7 Exploratory Research Projects (ERPs) designed to assist teams of researchers from Portuguese institutions, Carnegie Mellon University and industry partners, to bootstrap high-impact potential research activities of strategic relevance for the Carnegie Mellon Portugal Program.

A new call for ERPs was launched in 2019 to assist teams of researchers from Portuguese institutions, Carnegie Mellon University, and industry partners, to bootstrap high-impact potential research activities of strategic relevance for the CMU Portugal Program. The 2019 call for Exploratory Projects* was open to high-risk/high-reward ICT projects that showed promise and strategy for significant future expansion of the project’s goals. ERPs under this call should aim at formulating and launching longer-term projects, i.e., they will not be required to achieve, within their scope, the fully developed and ambitious final results that are typical of longer-term projects. However, the proposals must be very concrete on the activities and outcomes that the consortium have proposed to carry out and achieve in the scope of the ERP, and link them to its longer-term objectives. The 2019 call for proposals featured a total of 38 projects submissions from 20 different proponent Portuguese institutions and 9 CMU Departments. From this pool, an independent international committee recommended 7 projects for funding by Fundação para a Ciência e a Tecnologia under the scope of CMU Portugal. The selected projects will explore diverse themes such as robotics, artificial intelligence, intelligent transport systems, language processing, among others. The projects will run at 12 Portuguese research units from all over the country in collaboration with 4 different departments at Carnegie Mellon University (Computer Science; Electrical and Computer Engineering; Language Technologies Institute, Mechanical Engineering) and will benefit from overall funding of 814 000 €.

Announcement for the 2019 Call For Exploratory Research Proposals Under The Carnegie Mellon Portugal Program

Terms of Reference for CMU Portugal Exploratory Research Projects 2019
<table>
<thead>
<tr>
<th>Project</th>
<th>Portuguese PI</th>
<th>CMU PI</th>
<th>Portuguese Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic generation of humor for social robots</td>
<td>Ana Paiva (INESC-ID/IST)</td>
<td>Louis-Phillippe Morency (LTI)</td>
<td>INESC-ID; IST; ISCTE</td>
</tr>
<tr>
<td>CRUAV</td>
<td>Kai Li (ISEP)</td>
<td>Pei Zhang (ECE)</td>
<td>ISEP; FEUP</td>
</tr>
<tr>
<td>Intelligent Beamforming Metasurfaces for Future Telecommunications</td>
<td>Stanislav Maslovski (IT-Aveiro/UA)</td>
<td>Sheng Shen (MechE)</td>
<td>IT-Aveiro; UA</td>
</tr>
<tr>
<td>PassCert</td>
<td>João Ferreira (INESC -IF /IST)</td>
<td>Nicolas Christin (CS)</td>
<td>INESC-ID; IST; INESC-TEC</td>
</tr>
<tr>
<td>Privacy in speaker diarization: Detecting “who spoke when” privately</td>
<td>Isabel Trancoso (INESC-ID/IST)</td>
<td>Bhiksha Raj Ramakrishnan (LTI)</td>
<td>INESC-ID; IST</td>
</tr>
<tr>
<td>SecurityAware</td>
<td>Rui Maranhão (INESC-ID/IST)</td>
<td>Hakan Erdogmus (ECE)</td>
<td>INESC-ID; IST</td>
</tr>
<tr>
<td>Synthesizing Network Accelerators using Programmable Switching Equipment</td>
<td>Luis Pedrosa (INESC-ID/IST)</td>
<td>Justine Sherry (CS)</td>
<td>INESC-ID; IST; FCiências.ID</td>
</tr>
</tbody>
</table>
Exploratory Research Projects 2019

By CMU Departments and Portuguese institutions (proponent or participant)

- Computer Science Department: 2
- Electrical and Computer Engineering: 2
- Language Technologies Institute: 2
- Mechanical Engineering: 1
- ISEP/IPP INESC TEC FEUP: 3
- UAveiro IT Aveiro: 2
- INESC ID ISCTE-IUL FCIências.ID: 7

Total ERPs: 7
2019 ERPs

Title: Automatic generation of humor for social robots

Keywords: Humor · Human-Robot Interaction · Multimodal Interaction

Project Start Date: 01/01/2021  Project End Date: 31/12/2021

PT PI: Ana Paiva
PT CO PI: Patricia Arriaga
CMU PI: Louis-Phillippe Morency

Research Institutions:
Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; ISCTE – Instituto Universitário de Lisboa; Language Technologies Institute – Carnegie Mellon University

Summary

Humour is a natural and pervasive feature of everyday interactions. As technology, such as personal assistants and social robots, become more ingrained in peoples’ lives, humorous interactions between humans and these types of interactive computerized agents become increasingly more common. In this work, we argue that since humour is an important feature of human communication, it can be leveraged to create more naturalistic and lifelike interactions with robots and agents and general. Although, there is some work on “computational humour”, the complexity and subjectivity of humour appraisal and generation has led to most systems disregarding the users’ sense of humour and, as often happens in natural language processing, have the user adapting to the system instead of the other way around. The lack of context, the disregard of user’s preferences and the over-reliance on certain formats of jokes (e.g. word puns, one-liners) are still limitations found in a large number of current approaches to humour detection, classification and generation. The AGENTS’ project will leverage the power of humour to foster natural interactions with social robots by focusing on the delivery of user-personalized humour in naturalistic settings. We argue that psychological models of humour and its everyday functions can be used when attempting to create a top-down approach of humour that can be modelled to match each user’s preferences. We propose the creation of a dataset of jokes and the application of supervised machine learning techniques that will allow us to extract and automatize multimodal humour delivery according to the style of humour of the user. The long-term vision of this process would be the implementation of user personalized humoristic interactions in the context of a group card game involving more than one human and more than one robot. This is expected to lead to better interaction outcomes and increase the value perception of the robot, by contributing to greater user’s task enjoyment, more positive perception of the robots and intention to interact again with these social agents in the future.

Title: Intelligent Beamforming Metasurfaces for Future Telecommunications

Keywords: Antenna · Neural network · Metasurface · Beamforming

Project Start Date: 01/07/2020  Project End Date: 30/06/2021

PT PI: Stanislav Maslovski (UA)
PT CO PI: Nuno Borges Carvalho (IT)
CMU PI: Sheng Shen

Research Institutions:
Universidade de Aveiro (UA); Instituto de Telecomunicações (IT) Aveiro; Department of Mechanical Engineering at Carnegie Mellon University

Summary

The AI-BEAM project is devoted to developing intelligent, reconfigurable multibeam antennas for future device-to-device communications. Smart two-dimensional materials – programmable metasurfaces – powered by artificial intelligence (AI) techniques are proposed for high-throughput millimeter/submillimeter band communications. Metasurfaces have emerged as versatile tools for controlling wave fronts and performing nearly-instantaneous operations on the propagating electromagnetic waves. Offsetting parts of the signal processing and control associated with formation and tracking of communication beams to the metasurface layers results in reduction of computational overhead, which is required when dealing with the evergrowing throughput needs for future telecommunications. The proposed architecture enables real time and dynamic channel estimations and adaptive beamforming by using a trained AI network that incorporates the programmable metasurfaces as an integral part of such network.

Annual Report 18/19 - Carnegie Mellon Portugal

Knowledge Creation - Exploratory Research Projects
Title: PassCert – Exploring the Impact of Formal Verification on the Adoption of Password Security Software

Keywords: • Formal verification • Password security • Usable security

Project Start Date: 01/01/2021  Project End Date: 31/12/2021

PT PI: João Ferreira  
CMU PI: Nicolas Christin

Research Institutions:
Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Inesc Tec – Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência; Department of Computer Science- Carnegie Mellon University

Summary

Despite years of searching for viable alternatives, text passwords remain the dominant access control mechanism to access protected data. However, studies show that users tend to choose weak passwords that are easy to guess by password cracking software. To address this problem, security experts recommend the use of password managers that combine secure password storage and retrieval with random password generation. However, despite its critical importance, the adoption of password managers is still low. Reasons for this include distrust on the storage mechanisms and on the quality of generated passwords.

The goal of PassCert is to build a password manager that, through the use of formal verification, guarantees properties on data storage and password generation. The project aims to determine whether formal verification can increase users’ confidence in password managers and thus increase their adoption. The work developed in this project has the potential to improve the quality and security of current password managers and to increase their adoption, thus contributing to a more secure and resilient society.

Title: Privacy in speaker diarization: Detecting “who spoke when” privately

Keywords: • Diarization • Speaker turn • Deep learning • Cryptography

Project Start Date: 01/01/2021  Project End Date: 31/12/2021

PT PI: Isabel Trancoso  
CMU PI: Bhiksha Raj Ramakrishnan

Research Institutions:
Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Language Technologies Institute – Carnegie Mellon University

Summary

Automatic Speaker Diarization is often referred to as the problem of determining “who spoke when” in a recording. It allows users to search for specific speakers or audio events. In security applications, the target speaker may be a potential blacklisted criminal. In clinical interviews, it may be the patient. In language acquisition recordings it may be a child. The list of scenarios is extensive, encompassing courtrooms, meetings, sociolinguistic interviews, broadcast news, etc.

Delegating this task to an external service may jeopardize the speakers’ right to privacy. In fact, current AI models can determine from speech characteristics such as age, gender, height, weight, ethnicity, personality traits, and physical and mental health of the speaker. This project addresses these privacy issues by combining state-of-the-art diarization methods (e.g. speaker embeddings obtained from the hidden layers of deep neural networks) with cryptographic techniques such as homomorphic encryption and secure multi-party computation. The timeliness of this topic is more and more evident in a world where speech data and the info that may be extracted from it may be legally regarded as Personal Identifiable Information.
Title: SecurityAware: Fine-grained approach to detect and patch vulnerabilities

Keywords: · Security · Software Engineering · Static Analysis · Automated Program Repair

Project Start Date: 02/09/2020   Project End Date: 31/08/2020

PT PI: Rui Maranhão
CMU PI: Hakan Erdogmus

Research Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Department of Electrical and Computer Engineering – Carnegie Mellon University

Summary

Software vulnerabilities lead to massive financial losses for software companies as a result of business disruption, loss of privacy, reputation damage, legal implications, and life-threatening situations. Continuous Integration (CI), is an increasingly popular practice among modern development teams, as it enables a team to safely build, test, and deploy their code. However, due to the overwhelming amount of information generated by all of these phases and tools, software engineers feel that some of the production phases are frustrating and tend to ignore valuable output. Following the CodeAware vision (CodeAware is sensor-based fine-grained monitoring and management of software that can easily be integrated into the CI pipeline), we propose the development of a novel framework for automatically and efficiently detecting security issues that can be integrated with confidence on the CI pipelines through the implementation of more fine-grained approaches to CI static analysis. This research aims to (i) understand and evaluate how current static analysis techniques fare in vulnerability detection performance, and (ii) craft a unified technique that intelligently combines the output of several promising techniques to improve flexibility, and (iii) develop novel techniques to rank warnings to improve software engineers’ CI experience. All these exploratory approaches will be available as open source within the CodeAware framework to pave the way to other research works.

Title: Synthesizing Network Accelerators using Programmable Switching Equipment

Keywords: · Synthesis · Network Function Virtualization · Software-Defined Networking

Project Start Date: 01/10/2020   Project End Date: 30/09/2021

PT PI: Luis Pedrosa
PT Co-PI: Fernando Ramos
CMU PI: Justine Sherry
CMU Co-PI: Ruben Martins

Research Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Department of Computer Science – Carnegie Mellon University

Summary

From firewalls, to web caches, and even 4G and 5G network cores, network functions (NFs) are pivotal in modern networks. As developers and operators seek increased flexibility in the way they develop and deploy NFs, networks have been moving away from fixed-function hardware and exploring a variety of solutions from network function virtualization (NFV) to software defined networking (SDN) and even new classes of programmable network devices. This platform fragmentation introduces a new challenge: Can developers take advantage of multiple platforms without reimplementing NFs for each? Our goal with SyNAPSE is to allow programmers to write NF code once, and for a synthesizer to generate code for any or even a combination of the available platforms. With SyNAPSE we aim to not only create a proof of concept, but to also lay down the ground work for future research. 60 years ago compilers revolutionized the way software was developed. We imagine a future where synthesis can have a similar impact.
Large-Scale Collaborative Research Projects

In March 2019, the most ambitious call for research projects under the scope of the CMU Portugal, **Large-Scale Collaborative Research Projects**, was launched by Compete 2020, ANI, and FCT under the "Go Portugal – Global Science and Technology Partnerships Portugal" initiative sponsored by the Ministry of Science, Technology, and Higher Education. This call was open to projects partnering with two additional international partnerships under the strategic initiative GoPortugal.

Through the previous research calls, CMU Portugal has created new opportunities for the development of networks of world-class research and innovation, stimulating a culture of highly qualified entrepreneurship in Portuguese universities and creating an ecosystem of support for R&D activities by companies in close articulation with academic institutions. Research topics have also been aligned with the interests of Portuguese companies for the development of new products and/or services.

**Announcement 04/SI/2019 for System of Incentives for Research and Technological Development (SI R&D), Cooperation Projects - International Partnerships**

**Terms of Reference for projects submitted 04/SI/2019 for System of Incentives for Research and Technological Development (SI R&D), Cooperation Projects - International Partnerships**
The 2019 call aims to build from this previous experience, maintaining the path to strengthen the entrepreneurship competencies and R&D capacities of Portuguese companies and research institutions and promoting the internationalization of their R&I activities by exposing them to new dynamics through the CMU Portugal partnership. The projects’ leadership is now given to the national companies that assume the role of dynamizing networks and collaborative projects, relying on Portuguese R&D institutions and taking advantage of the experience and knowledge of Carnegie Mellon. Thus, it seeks to complete the transition process of International Partnerships, from an initial model that is based on the dynamism of Portuguese universities, for a model that gives Portuguese companies the leadership of the process of modernizing the national economic fabric, reinforcing the innovation ecosystem. Therefore, the projects are led by a Portuguese company, carried out in partnership between companies and non-corporate entities of the R&D System and with the participation of at least one CMU principal investigator. For 3 years, the projects should involve industrial research and experimental development activities, leading to the creation of new products, services, processes, and systems. This may also include the introduction of significant improvements in existing products, services, processes, or systems. Projects under the CMU Portugal Program should address issues that are relevant to the industry covering one or more of the following topics:

- Data Science and Engineering;
- Artificial Intelligence, Machine Learning, Language Technologies, Data Analytics and Cloud Computing;
- Autonomy and Mobility;
- Design in a Variety of Societal Settings and Applications such as tourism, logistics or creative industries.

Additionally, it is intended that these projects will help to reinforce the intergovernmental “Atlantic Interactions”, a new intergovernmental initiative to unleash the potential of the Atlantic for Society implemented through the Atlantic International Research Centre (AIR Centre).

The initial total funding available for the CMU Portugal Program was 5M, with an indicative budget of 1,25 M€ per project. Under this call, ANI, the governmental body responsible for receiving and evaluating the projects, received 41 applications corresponding to a proposed global investment of over 71M€, of which almost half (34.6M€) represent companies’ investment. With 17 projects, the CMU Portugal Program registered the most significant number of applications, with the other 2 international partnerships receiving 14 and 10 applications. The 17 applications involved 32 promoters, 25 of which were companies (17 leaders and 8 partners) and 17 were non-corporate entities of the Research and Innovation System (SI&I), revealing a substantial commitment of the national innovation ecosystem.
in partnering with CMU experience and expertise. An independent international committee organized by ANI, evaluated the 41 proposals submitted under this call and selected for funding 25 projects increasing the total funding to 55.2€ M for the next 3 years, including € 16.7M financed by American Universities and € 7.7M of business self-financing.

Due to the high quality of the 17 proposals submitted, 10 of the 25 approved projects will occur in collaboration with CMU under the scope of the CMU Portugal Program. Overall the 10 selected projects represent a commitment of 21M€ from public funding (PT2020 and FCT) and companies’ investment into ICT R&D: 11.4 M€ come from the European COMPETE 2020 Program and the Portugal Foundation for Science and Technology (FCT); 6M€ are through the CMU Portugal Program at CMU; and 3.5M€ from Portuguese ICT companies.

Portuguese companies lead all projects in partnership with 13 research groups from Portuguese Universities and research groups from 8 different departments at CMU. The projects will be led by top national ICT companies, including the CMU Portugal Program startup Feedzai and Unbabel, which are now reinvesting in R&D, Compta, Farfetch, First Solutions, Glintt, GLSMED Learning Health, Ingeniarius, Mobileum and Outsystems. In addition to these 10 companies, the projects will involve 18 other Portuguese Institutions, from Universities to Research Labs, Hospitals, and Companies plus 8 different CMU Departments (Civil and Environmental Engineering, Computer Science, Engineering Research Accelerator, Heinz College of Information Systems and Public Policy, Institute for Software Research, Language Technologies Institute, Mechanical Engineering, Robotics Institute).

The awarded projects cover the areas of Data Science and Engineering, Artificial Intelligence and Machine Learning, Design and Engineering applied to social problems, addressing problems in the health sectors, forest fire-prevention, data management, mobility, and language technologies. A summary of each project can be found here bellow.
Large-Scale Collaborative Research Projects

By CMU Departments and Portuguese research institutions

Industry Promoters

- Compta- Emerging Business S.A.
- Farfetch Portugal - Unipessoal LDA
- Feedzai - Consultoria e inovação tecnológica, S.A.
- First Solutions- Sistemas de informação S.A.
- Glint- Health care solutions, S.A.
- Glsm Learning Health, S.A.
- Ingeniarius, LDA
- Mobilium
- Outsystems - Software em redes S.A.
- Unbabel, LDA

Industry Co-Promoters

- Piberam Informática, S.A.
- Hospital da Luz S.A.
- Silvapor, Ambiente & Inovação LDA
- 3 Drivers - Engenharia, Inovação e Ambiente, lda

Large-Scale Collaborative Research Projects

- Computer Science Department
- Civil and Environmental Engineering
- Institute for Software Research
- Language Technologies Institute
- Heinz
- Robotics Institute
- Engineering Research Accelerator
- Mechanical Engineering
- Administração Rregional de Saúde do Norte, I.P.
- Associação Fraunhofer Portugal Research
- INESC TEC - Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência
- Associação para o Desenvolvimento da Aerodinâmica Industrial
- Centro Hospitalar e Universitário de Coimbra, E.P.E.
- Instituto de Sistemas e Robotica-I.S.R.
- Universidade de Coimbra
- Faculdade de Ciências da Universidade de Lisboa
- INESC ID - Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa
- Instituto de Telecomunicações
- Instituto Superior Técnico
- IST-ID, Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento
- Universidade Nova de Lisboa

LSCRP

10

By CMU Departments and Portuguese research institutions
In summary, since 2006, the CMU Portugal Program has launched nine calls for research projects and has supported 55 R&D projects to which we now add 10 Large-Scale, and 7 ERP to an overall number of 72 projects. In 2020, the new projects will further support CMU Portugal’s mission to place Portugal at the forefront of research and technological development in ICT. Throughout the year, 10 large-scale projects and 7 new ERPs will begin, representing the most significant public and private financial commitment to date under the scope of the CMU Portugal Program. These new projects reflect CMU Portugal’s commitment to fostering the cooperation between Portuguese university researchers and Portuguese companies, promoting innovation and technology development directly impacting the competitiveness of Portuguese companies in the global market.
2019 Large-Scale Collaborative Research Projects

Title: AIDA: Adaptive, Intelligent and Distributed Assurance Platform

Global Investment (Private + Public): €1,883,005.93
Leading company in Portugal: Mobileum

Project Start Date: 01/05/2020
Project End Date: 31/10/2020

Summary
RAID is Wedo's flagship end-to-end real-time data management platform handling the entire risk management lifecycle of enterprises. RAID provides a highly flexible and robust processing pipeline consisting of data collection, monitoring, notification, discovery and actuation phases. Wedo's platform is currently applied around the world to handle, among others, revenue assurance, business assurance and fraud management.

The overarching goal of the AIDA project is to conceive a new version of the current Wedo platform in which some of the pipeline phases can be dynamically moved to the edges of the system. As of today, the platform is fully deployed in physically colocated servers, either on premises or in the cloud. While some phases are likely to always be kept under the platform's service owner, with AIDA, data collection and monitoring, and even actuation phases should be prepared to run in diverse hardware architectures outside the platform's owner physical or even administrative control. AIDA should provide for highly configurable data collection and monitoring while preserving the current real-time, security and dependability guarantees.

A complete prototype of AIDA will be deployed and demoed by the end of the project in a realistic scenario in the area of telecommunication services.

Partner Institutions and Team Members:

<table>
<thead>
<tr>
<th>Promoter</th>
<th>Mobileum</th>
</tr>
</thead>
</table>
|          | Ricardo Marques  
|          | Carlos Martins  
|          | David Sampaio  
|          | Helder Marques  
|          | Raul Azevedo  
|          | Rosa Vieira  |

<table>
<thead>
<tr>
<th>Academic Co-Promoters</th>
<th>INESC TEC - Instituto de Engenharia De Sistemas e Computadores, Tecnologia e Ciência</th>
</tr>
</thead>
</table>
|                       | Ricardo Vilaça  
|                       | Alípio Jorge  
|                       | João Gama  
|                       | João Vinagre  
|                       | José Pereira  
|                       | Paula Rodrigues  
|                       | Rui Camacho  
|                       | Rui Oliveira  |

<table>
<thead>
<tr>
<th></th>
<th>Universidade de Coimbra</th>
</tr>
</thead>
</table>
|                       | Marco Vieira  
|                       | Edmundo Monteiro  
|                       | João P. Vilela  
|                       | José Flora  
|                       | Marília Curado  
|                       | Nuno Antunes  |

<table>
<thead>
<tr>
<th></th>
<th>Computer Science Department at Carnegie Mellon University</th>
</tr>
</thead>
</table>
|                       | Christos Faloutsos  
|                       | David Garlan  
|                       | Justine Sherry  
|                       | Rashmi K. Vinayak  |
Title: BEE2WasteCrypto

Keywords: Waste · PAYT · Blockchain

Global Investment (Private + Public): 2 701 173,98 €
Leading company in Portugal: COMPTA – EMERGING BUSINESs

Project Start Date: 01/05/2020
Project End Date: 30/04/2023

Summary

Bee2WasteCrypto will focus on data science to maximize value and contribute to a sustainable waste management strategy at a local level with a global scope. It will develop a new and innovative IT tool that aim to contribute to empower Regional Waste Management Utilities (RWMU) in their dual role of designers and managers of decentralized and customized solutions and as promoters of new citizen behavior in terms of waste generation and handling. The RWMUs will be able to choose the best set of technologies to help in their operation, namely in terms of the quality and quantity of waste generated and also regarding materials to be produced from waste processing, under environmental and economic criteria; This IT tool will facilitate Pay As You Throw (PAYT) schemes, by using blockchain technologies to produce liable information and establish recycling rate credits based on the performance of each RWMU in the national recycling scenario (an analogue of carbon credits in the energy sector).

Partner Institutions and Team Members

<table>
<thead>
<tr>
<th>Promoter</th>
<th>Industry Co-Promoters</th>
<th>Academic Co-Promoters</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPTA - Emerging Business, S.A.</td>
<td>3 DRIVERS - Engenharia, Inovação E Ambiente, Lda</td>
<td>Universidade Nova de Lisboa</td>
</tr>
<tr>
<td>Paulo Fernandes</td>
<td>António Lorena</td>
<td>Miguel Neto</td>
</tr>
<tr>
<td></td>
<td>Instituto Superior Técnico</td>
<td>Paulo Ferrão</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Civil and Environmental Engineering at Carnegie Mellon University</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H Scott Matthews</td>
</tr>
</tbody>
</table>
**Title:**
CAMELOT: autonomiC plAtform for MachinE Learning using anOnymized data

**Keywords:**
- Fraud detection
- Machine Learning
- Anonymization

**Global Investment (Private + Public):** 1 998 086,94 €

**Leading company in Portugal:** FEEDZAI

**Project Start Date:** 01/05/2020
**Project End Date:** 30/04/2022

**Summary**

The CAMELOT (autonomiC plAtform for MachinE Learning using anOnymized daTa) project aims at developing an innovative machine learning platform, which will tackle three key issues that hinder the efficiency and accuracy of modern AI applications:

- Ensuring real-time constraints during both the training and inference phases of machine learning models, while minimizing operational costs deriving from the use of cloud resources.

- Enabling learning over anonymized data, thus circumventing the privacy issues that currently prevent the reuse of information across models trained on datasets belonging to different entities (e.g., different financial institutions).

- Integrating information from different, independent and heterogenous data plataforms (e.g., key-value stores, relational and graph databases) in an automatic approach that maximizes the performance of machine learning applications.
Title: GOLEM: Automated Programming to Revolutionize App Development

Keywords: Automated-Programming • Program-Synthesis • App-development

Global Investment (Private + Public): 1 860 048,76 €
Leading company in Portugal: OUTSYSTEMS

Project Start Date: 01/05/2020
Project End Date: 30/04/2023

Summary

All businesses need to become digital to survive. However, there’s a shortage of talent for programming enterprise applications. And the problem is only getting worse.

GOLEM will enable everyone to create enterprise applications with no code. It will all be made possible through Artificial Intelligence (AI) and a rich set of language abstractions. OutSystems is aiming high to automated programming, guided by the user through natural interaction.

GOLEM will advance the state-of-the-art of AI applied to code, program synthesis, and all automated programming techniques. OutSystems will set a new benchmark for easy-to-use enterprise application development platforms, and revolutionize the low-code and no-code development market.
Title:
ifetch: Multimodal conversational agents for the online fashion marketplace

Keywords:
- Conversational Agents
- Machine Learning
- E-Commerce

Global Investment (Private + Public): 2 364,910,44 €
Leading company in Portugal: FARFETCH PORTUGAL

Project Start Date: 01/04/2020
Project End Date: 31/03/2023

Summary

Conversational systems have seen a significant rise in demand due to modern commercial applications using these types of systems such as Amazon's Alexa, Apple's Siri, Microsoft's Cortana and Google Assistant. Multimodal chatbots is a widely unexplored area, where users and the conversational agent communicate by natural language and visual data.

iFetch proposes to research and deliver a new generation of task-oriented conversational agents that interact with users using verbal and visual information in a seamless manner. The project ambition is to make research on the technology that will make an impact for the future. To fulfil this ambition, two critical research challenges will be addressed: a) tracking the evolution of the information needed in the conversation, with memory neural networks; b) visual data analysis that can relate product categories and characteristics to the conversation, thus leading to a better user engagement in the shopping experience.

iFetch is at the core of a dominant technology that, in the near future, will empower consumers, constituents and citizens to access information more naturally and thus take better informed decisions.

Partner Institutions and Team Members

| Promoter | FARFETCH PORTUGAL - Unipessoal Lda | Ricardo G. Sousa
|          |                                  | Luís Carvalho
          |                                  | Marcus Wittmann
          |                                  | Marcelo Fernandes
| Academic Co-Promoters | Universidade Nova De Lisboa | João Magalhães
|                      | Instituto Superior Técnico | Nuno Correia
|                      | The Language Technologies Institute at Carnegie Mellon University | Flávio Martins
|                      |                              | David Semedo
|                      |                              | João Paulo Costeira
|                      |                              | João Xavier
|                      |                              | Jacinto Nascimento
|                      |                              | Carlos Santiago
|                      |                              | João Pedro Gomes
|                      |                              | Alexander Hauptmann
|                      |                              | Alexander I Rudnicky
Title: **IntelligentCare: Intelligent Multimorbidity Management System**

**Keywords:**  
- Health Data Science  
- Value-based healthcare  
- Multimorbidity

**Global Investment (Private + Public):** 2,554,042.26 €  
**Leading company in Portugal:** GLSMED LEARNING HEALTH

**Project Start Date:** 01/04/2020  
**Project End Date:** 01/04/2023

**Summary**

The growing population aging with multimorbidity (MM) hinders the sustainability of the healthcare sector. MM is typically associated with high healthcare usage and costs, which do not always translate to better outcomes for patients. Consequently, there is a significant need to develop new tools to manage this condition.

The IntelligentCare project aims to develop a patient centric and personalized tool to manage MM using analytical methods to explore data from electronic health records as well as measures reported remotely by patients, such as life events, quality of life and physical activity, amongst others, using smart sensors and mobile solutions. The IntelligentCare tool will aid clinicians and other health care professionals in the process of understanding and predicting individual patient interactions with the hospital, with the ultimate goal of improving quality of care for MM patients while contributing to hospital resources optimization, effectively moving towards a value-based healthcare model.

---

**Partner Institutions and Team Members**

| Promoter                        | GLSMED Learning Health, S.A.                       | Francisca Leite  
|                                |                                              | Nuno André da Silva  
|                                |                                              | Rita Eça  
|                                |                                              | Carlota Lucena  
|                                |                                              | Vera Vilar  
| Industry Co-Promoters          | Priberam Informática, S.A.                     | Cláudia Pinto  
|                                |                                              | Zita Marinho  
|                                |                                              | David Nogueira  
|                                | Hospital da Luz S.A.                          | Bernardo Neves  
|                                |                                              | João Sequeira Carlos  
|                                |                                              | Filipe Costa  
| Academic Co-Promoters          | INESC ID - Instituto de Engenharia De Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa | Mario Gaspar Silva  
|                                |                                              | Bruno Martins  
|                                | IST-ID, Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento | José Santos Victor  
|                                |                                              | Plinio Moreno  
|                                |                                              | Alexandre Bernardino  
|                                |                                              | José Gaspar  
|                                |                                              | Jorge Marques  
|                                | Heinz College of Information Systems and Public Policy at Carnegie Mellon University | Pedro Ferreira  
|                                |                                              | Rema Padman  
|                                |                                              | Jeremy Weiss  
|                                |                                              | Asim Smailagic  

---

**Promoter**

GLSMED Learning Health, S.A.

Francisca Leite  
Nuno André da Silva  
Rita Eça  
Carlota Lucena  
Vera Vilar

**Industry Co-Promoters**

- Priberam Informática, S.A.
- Hospital da Luz S.A.
- Bernardo Neves
- João Sequeira Carlos
- Filipe Costa

**Academic Co-Promoters**

- INESC ID - Instituto de Engenharia De Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa
- Mario Gaspar Silva
- Bruno Martins
- José Santos Victor
- Plinio Moreno
- Alexandre Bernardino
- José Gaspar
- Jorge Marques

Heinz College of Information Systems and Public Policy at Carnegie Mellon University

Pedro Ferreira  
Rema Padman  
Jeremy Weiss  
Asim Smailagic

---
Title: MAIA: Multilingual Virtual Agents for Customer Service

Keywords:  
• AI  
• Machine Translation  
• Conversational support

Global Investment (Private + Public): 2 251 038,72 €
Leading company in Portugal: UNBABEL

Project Start Date: 01/04/2020
Project End Date: 31/03/2023

Summary

The growing population aging with multimorbidity (MM) hinders online conversational support – chat – being the fastest growing customer service channel, being the preferred way for millennials to obtain customer service. Today, supporting international customers in this channel is mostly done by using human agents that speak different languages – a scarce and costly resource. On MAIA, we’ll develop a multilingual conversational platform, supported by machine translation and dialogue systems, where human agents are assisted by AI agents. This approach will overcome limitations of existing customer service channels by targeting the following scientific and technological goals:

• New memory-efficient neural models for context-aware machine translation
• New answer generation techniques to support the decisions of human agents
• New techniques for conversational quality estimation and sentiment analysis
• Integration of the scientific advances above into a full end-to-end product

Partner Institutions and Team Members

Promoter

| UNBABEL, LDA | Ricardo Joge Ferreira Araújo |
| Vasco M. R. Calais Pedro |
| João de Almeida V. Graça |
| Alon Lavie |
| Flávio M. Rocha Azevedo |
| Ana Marisa Rocha Correia |
| Paulo Arrais Dimas Almeida |
| João Luís Vazão Vasques |
| CarlaTeresa Escartin Parra |
| Catarina da Cruz Coelho da Silva |
| Miguel F. M. Sousa Filipe |
| Jonay Gaël Trénous |
| Fábio Natanael Kepler |
| Mohammad Amin Farajian |
| António Luís V. dos Santos Lopes |
| António Miguel da Rocha G. Góis |
| Ricardo Costa Dias Rei |
| Luís Filipe Pinto Bernardo |
| Miguel Coimbra Vera |
| Christine Anne Maroti |
| Artur David Félix Ventura |
| Fernando Miguel Ferrão do Amaral |
| Filipe Domingos Simões Barbosa |
| Gina Dragulin |
| Sónia Maria da Luz Coelho Romão |
| Sónia Maria da Luz Coelho Romão |
| Sebastien B. Christophe Prioris |
| Eduardo Fierro Farah |
| Tiago Manuel Paulo Travanca |
| João Daniel Fernandes Godinho |
| José Maria Pedro Libano Monteiro |
| Rui Pedro Duarte Santos |
| Sofia Carla Gregório Perdigão |
| Bruno Alù Bacarini |
| Mariana Ferreira Amaro e Silva |

Academic Co-Promoters

| Instituto de Telecomunicações | André Martins |
| Mário Figueiredo |
| Vlad Niculae |
| INESC ID - Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa | Helena Moniz |
| Isabel Trancoso |
| Luisa Coheur |
| João Paulo Carvalho |
| The Language Technologies Institute at Carnegie Mellon University | Graham Neubig |
| Internship from CMU |
Title: Safeforest: Semi-Autonomous Robotic System for Forest Cleaning and Fire Prevention

Keywords: •Forestry robotics •Sustainable forest management •Wildfire prevention

Global Investment (Private + Public): 1 671 167,64 €
Leading company in Portugal: INGENIARIUS

Project Start Date: 01/03/2020
Project End Date: 01/03/2023

Summary

The world has been affected by an alarming number of wildfires every year, ravaging millions of hectares of forestry areas and resulting in an unacceptable amount of human losses. SafeForest deals with the development of an advanced robotic system for the prevention of wildland and wildland-urban interface (WWUI) fires. Vegetation cleaning in corridors along high voltage electric lines will be central in the project to avoid forest fire risks that recently led to massive fires in countries, such as USA and Portugal. The SafeForest consortium will design a semi-autonomous robot system to clean vegetation in rough and sloppy areas, creating opportunities for controlling fire propagation and to prevent the possibility of larger forest fire events. SafeForest will also encompass the design of an advanced mapping and characterization system of the terrain and its detailed vegetation cover. These ambitious objectives will pave the way towards the deployment of autonomous and semi-autonomous forest maintenance strategies to significantly reduce wildfire hazard potential, thus conserving natural resources and creating ecosystems that are resilient to climate change.

Partner Institutions and Team Members

<table>
<thead>
<tr>
<th>Promoter</th>
<th>INGENIARIUS, LDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Micael Couceiro</td>
</tr>
<tr>
<td></td>
<td>Ahmad Nasir</td>
</tr>
<tr>
<td></td>
<td>André Araújo</td>
</tr>
<tr>
<td></td>
<td>Samuel Pereira</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry Co-Promoters</th>
<th>SILVAPOR, Ambiente &amp; Inovação Lda</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>José Gameiro</td>
</tr>
<tr>
<td></td>
<td>Cátia Caroço</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academic Co-Promoters</th>
<th>Instituto de Sistemas e Robotica-I.S.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aníbal de Almeida</td>
</tr>
<tr>
<td></td>
<td>João Filipe Ferreira</td>
</tr>
<tr>
<td></td>
<td>Luís Ferreira</td>
</tr>
<tr>
<td></td>
<td>Paulo Peixoto</td>
</tr>
<tr>
<td></td>
<td>Urbano Nunes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academic Co-Promoters</th>
<th>Assosiação Para O Desenvolvimento Da Aerodinamica Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domingos Xavier Viegas</td>
</tr>
<tr>
<td></td>
<td>Carlos Viegas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academic Co-Promoters</th>
<th>The Robotics Institute at Carnegie Mellon University</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kantor George</td>
</tr>
<tr>
<td></td>
<td>David Wettergreen</td>
</tr>
<tr>
<td></td>
<td>Pei Zhang</td>
</tr>
</tbody>
</table>
Title: TAMI: Transparent Artificial Medical Intelligence

Keywords:
- Artificial intelligence
- Computer-aided decision
- Healthcare

Global Investment (Private + Public): 1 791 467.33 €
Leading company in Portugal: FIRST SOLUTIONS

Project Start Date: 01/04/2020
Project End Date: 01/03/2023

Summary

The aim of the project TAMI is to create a new platform for commercial, scientific and academic use that will provide "consumers" access to results and explanations of registered diagnostic orders, filtered data sets access for investigators or scientists and a knowledge base for academic purposes. In order to accomplish that, TAMI will use clinical data from structured image data, in order to design and validate interpretable machine learning models. Different multimodal settings will be tested to allow for a better understanding of the AI-based decisions. Moreover, the algorithms will be designed to generate self-explanatory AI-based decisions, minimise bias, and act ethically in their context.

Proof-of-concepts and demonstrators of how to integrate the researched explainable AI into workflows of cervical cancer treatment, pathology detection in chest X-Ray images, and glaucoma detection in retinal fundus images will be developed to validate the algorithmic solutions.

Partner Institutions and Team Members

<table>
<thead>
<tr>
<th>Promoter</th>
<th>FIRST SOLUTIONS - Sistemas de Informação S.A.</th>
<th>Celestino Ramalho Francisco Borges João Monteiro Márcio Barreto Marta Rodrigues Rute Jesus Susana Seixas Tiago Oliveira</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Co-Promoters</td>
<td>Associação Fraunhofer Portugal Research</td>
<td>André Pereira Cristiana Braga Filipe Soares Luis Rosado Micaela Amaral Paulo Silva Pedro Almeida Pedro Faria Teresa Conceição</td>
</tr>
<tr>
<td></td>
<td>INESC TEC - Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência</td>
<td>Ana Filipa Sequeira Ana Maria Mendonça Aurélio Campilho Catarina Carvalho Hélder Oliveira Jaime Cardoso Joao Pedrosa Wilson Silva</td>
</tr>
<tr>
<td></td>
<td>Administração Regional De Saude Do Norte, I.P.</td>
<td>Carla Costa Helena Pereira Joana Abreu Pedro Sousa</td>
</tr>
<tr>
<td></td>
<td>Engineering Research Accelerator at Carnegie Mellon University</td>
<td>Asim Smailagic Alex Gaudio Christos Faloutsos Hyun Ah Song Klas Leino Matt Fredrickson Matt Gormley Xinhe Zhang</td>
</tr>
</tbody>
</table>
Title: **Wow: Wireless biOmonitoring stickers and smart bed architecture: toWards Untethered Patients**

**Keywords:**
- Electronic skin (e-skin) patches
- Wireless patient monitoring
- IoT infrastructure

**Global Investment (Private + Public):** 1 755 235,90 €

**Leading company in Portugal:** GLINTT – HEALTHCARE SOLUTIONS

**Project Start Date:** 01/04/2020
**Project End Date:** 01/04/2023

**Summary**

Electronic skin (e-skin) patches that adhere to the human epidermis and collect physiological and behavioral data are potentially transformative in patient monitoring to identify physiological and emotional responses through the collection and classification of data, including heart, muscle and brain activities, respiration rate, body temperature, contractions during pregnancy, IR Response, blood oxygen, sweat analysis, body motion, and emotional state through Galvanic Skin Response (GSR).

Wow proposes a novel architecture centered on untethered, simple and low-cost printed biomonitoring stickers, in which patients’ beds will have a central role, being equipped with a smart IoT unit. The bed-sticker connection allows not only for data acquisition and transmission, but also enables energy transmission to the stickers. Each bed is an IoT node that communicates with Globalcare, a proprietary Hospital Information System developed by the project leader company - Glintt.

**Partner Institutions and Team Members**

<table>
<thead>
<tr>
<th>Promoter</th>
<th>Instituto de Sistemas e Robotica-I.S.R.</th>
<th>Aníbal T. de Almeida Mahmoud Tavakoli Paulo Peixoto</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Universidade de Coimbra</td>
<td>Jorge Coelho Arménio C. Serra</td>
</tr>
<tr>
<td></td>
<td>Centro Hospitalar e Universitário de Coimbra, E.P.E.</td>
<td>Patricia Dias</td>
</tr>
</tbody>
</table>
Innovation and Entrepreneurship
Industrial Affiliates

The CMU Portugal Program has been working to establish a very close relationship with the Portuguese industry, namely through the companies that are part of its Industrial Affiliates Program. Since 2018, 14 CMU Portugal Industrial Affiliates have committed to actively contribute to the advanced education and research programs of the partnership and also to increase their competitiveness by investing in R&D, in advanced training of human resources, and in building a highly-skilled workforce dedicated to innovation activities. CMU Portugal Industrial Affiliates include 3 Portuguese unicorn companies (Farfetch, Outsystems and Talkdesk), 3 CMU Portugal startups (Feedzai, Unbabel, and Veniam) and ICT leaders (Accenture, Altice, CEiiA, NOS, Priberam, REN, Tekever, Thales, and Uniplaces). Furthermore, Farfetch, Feedzai, Outsystems, and Unbabel reinforced their commitment to the Program by leading 4 out of the 10 CMU Portugal Large-Scale Projects that will start in 2020. Together, the 14 CMU Portugal Industrial Affiliates support the strategic management and development of the Program and promote their affirmation as technology-based companies, intending to significantly strengthen their R&D and qualified employment by 2030. Within the scope of the data economy, the industrial affiliates cover a wide range of sectors enriching the Program’s ecosystems and network.

Industry Involvement in Projects

The Entrepreneurial Research Initiatives (ERIs), combined research, innovation, advanced training initiatives, and established collaborations between academia and Portugal and at Carnegie Mellon and with industry. The 12 projects were developed in partnership with 46 companies from different sectors of activity, with industry involvement translating to a 2.6M€ financial commitment by private companies. Furthermore, technological companies have had their R&D activities suc-
cessfully integrated with the activities of the academic partners, and have developed corresponding plans to improve their solutions, or collaboratively formulate new solutions. User companies have provided access to test-bed infrastructures, critical for the success of these projects. The potential impact of these collaborations is overall assessed as high. It features a multi-level nature, ranging from benefits to end-users (such as patients, tourists, or businesses), to benefits to established companies (through improved, new, or complementary solutions to be commercialized), to contributions to the definition of enhanced industrial policies and practices. These synergies also led to significant outputs with an emphasis on the development and commercialization of new technology with economic and societal impact, with projects reported the construction of 87 prototypes and the submission of 10 new patents.

The CMU Portugal Call for flagship Large-Scale Collaborative Research Projects has created a new strategy for Industry engagement with companies as the leading Project promoters as well as investors, with nearly 3.5 M€ of private funding. Companies are now responsible for the dynamizing networks, relying on Portuguese R&D institutions and Carnegie Mellon, therefore taking the lead in modernizing the national economic fabric and reinforcing the innovation ecosystem. The 10 selected projects will be led by top national ICT companies, including the CMU Portugal Program startup Feedzai and Unbabel, which are now reinvesting in R&D, Compta, Farfetch, First Solutions, Glintt, GLSMED Learning Health, Ingeniarius, Mobileum, and Outsystems. In addition to these 10 companies, 4 others joined the consortiums as co-promoters including Priberam Informática, S.A- also a CMU Portugal Industrial Affiliate –Hospital Da Luz S.A., Silvapor, Ambiente & Inovação Lda and 3 Drivers – Engenharia, Inovação E Ambiente, Lda. The research networks will be completed by 14 other Portuguese Institutions, from Universities to Research Labs, and 8 different CMU Departments. Overall, 5 out of the 14 CMU Industry affiliates – Farfetch, Feedzai, Outsystems, Priberan, and Unbabel – are involved in the Large-Scale Collaborative Research Projects, reinforcing their commitment to the CMU Portugal Program. It is this consideration that the data economy, due to its transversal nature, requires companies to get closer to cutting-edge research and from this results to real applications and problem solutions.
CMU Portugal has also been a hub for faculty members, students, and alumni to launch their entrepreneurial initiatives. The Program has 12 startups that have been launched or facilitated by activities of the Program: Dognaedis, Feedzai, Geolink, Mambu, Orange Bird, Prsma, Red Light, Sentilant, Streambolico, Veniam and Unbabel. Together these companies have attracted more than $200 million in venture capital investment, created over 1,000 highly qualified jobs, and are already a reference in their activity sector, such as Feedzai and Unbabel - who are also part of the CMU Portugal Industry Affiliates - and Veniam.

Dognaedis

Dognaedis is a startup established by Mário Zenha-Rela, faculty at the Faculdade de Ciências e Tecnologia da Universidade de Coimbra (FCTUC) and Francisco Rente, a Ph.D. student. The main business focus of this company is Information Security, focused in three major activity areas: Security Audit and Consultancy, Software Assurance and Business Continuity Support. This start-up was created because of all the involvement that Mário Zenha-Rela has had within the partnership: he spent a semester at Carnegie Mellon in the beginning of the Program to get the accreditation to teach some courses. During this stay he felt that Carnegie Mellon faculty were encourage having a strong relation with the industry world, through consultancy services or even creating their own companies. When he returned to Portugal, he started working in both, and after a while he decided jointly with a Ph.D. student to create his own company. Dognaedis works for the Portuguese central administration: the Internal Affairs, the Ministry of Justice, and the National Health Emergency Institute, and to several companies.
FeedZai

FeedZai is another start-up created as a result of the Carnegie Mellon Portugal Program. Paulo Marques and Pedro Bizarro, two faculty members of the Faculdade de Ciências e Tecnologia da Universidade de Coimbra (FCTUC), and Nuno Sebastião, product manager at the European Space Agency (ESA), embarked on the adventure to create a startup specialized in processing large volumes of data with low-latency producing actionable information in real-time.

This company brought to the market a revolutionizing product in terms of real-time data processing, which allows companies to look into their data in real-time, as things are happening, and understand in detail what is going on. It allows a telecommunication operator to know in real-time how its network traffic is behaving and if it is following a ‘normal’ pattern or not; it allows an electrical utility company to understand in detail the load that is taking place in the network and if there are ‘unexpected leaks’ occurring. The partnership with Carnegie Mellon University was very important in this process. Both, Paulo Marques and Pedro Bizarro were adjunct professors at Carnegie Mellon University which granted the company a high degree of credibility which was critical when trying to convince an established company to try out a new technology. On the other hand, there are a number of activities that the Carnegie Mellon Portugal program has been promoting, where this startup have been present, which opened FeedZai to new markets.

GeoLink

GeoLink is a start-up created by Michel Ferreira, faculty at the Faculdade de Ciências da Universidade do Porto (FCUP), focused in the management of geospatial information. This start-up is fully involved in the Carnegie Mellon Portugal partnership throught the participation on the research project approved for funding in the Call of 2008: DRIVE-IN - Distributed Routing and Infotainment through Vehicular Inter-Networking, which equipped 500 taxi cabs in the city of Porto.

GeoLink has a team with an expertise in the area of technology systems for the management of spatial information that joins research and helps to solve problems of high complexity finding innovative solutions grounded in technology.
Mambu

Mambu is a startup company established by two alumni of the Master in Human Computer Interaction, namely Eugene Danilkis and Frederick Pfifered. This company was designed to support the unique needs of small and medium sized organizations (MFIs) providing microcredit services. It was built by working closely with organizations, observing their work and determining their needs and challenges.

The idea to create this company started during their Professional Master when they made their Capstone Project, a mandatory project were students work in interdisciplinary teams with an industry sponsor to produce a working prototype that serves as a proof of concept of a novel service or product idea. Mambu was the name of the project created by these two entrepreneurs with more colleagues, which goal was to build an online portfolio management software service for growing microcredit organizations.

Orange Bird

Established in May 2011, Orange Bird is a startup created by Paulo Silva Pereira, Pedro Domingos and Yoann Nesme, all 3 full-time students of the International Lisbon MBA, together with Professor Pedro Oliveira from the Católica Lisbon School of Business and Economics and director of the Dual-Degree doctoral program in Technology Change and Entrepreneurship offered by Católica-Lisbon, IST/UTL and CMU in the scope of the Carnegie Mellon Portugal Program, who is conducting research on the role of users in developing innovative financial services, including crowdfunding.

The goal of this startup is to promote the concept of crowdfunding (collective finance) in Portugal and to boost entrepreneurship and social development within the country, through a crowdfunding interface called PPL.
Prsma

Prsma is a company created by a M-ITI team associated with an entrepreneur from the electronics industry, to commercialize “ENERGY SPECTRUM”, a system developed and tested in the framework of a success research project. Their sensing system is capable of disaggregating home energy consumption using a low-cost and effective non-intrusive approach. The sensing system is coupled with a middleware web system that supports novel eco-feedback strategies that are meaningful and compelling for families and households.

RedLight Software is a process-driven software company providing solutions for the health sector in Europe. It is a technological startup originated from the Carnegie Mellon Portugal initiative as a direct outcome of the multidisciplinary partnership in software engineering, quality processes (CMMI) and human-computer interaction. It was created by Mário Zenha-Rela, professor and researcher at Faculdade de Ciências e Tecnologia of the Universidade de Coimbra.

RedLight Software is developing a cloud-based multiplatform line of products targeting chronic disease management (starting with Type 2 Diabetes) to be launched at the first quarter of 2014. RedLight was incorporated in January 2013 and has currently clients in three European Countries.
Sentilant

Sentilant, a spinoff from the Universidade de Coimbra, created in the scope of the CMU Portugal Program, was co-founded in May 2013 by Bruno Cabral and Jorge Granjal, faculty members of the Universidade de Coimbra. The company is currently headquartered at Instituto Pedro Nunes, in Coimbra.

Sentilant provides services and software products that allow people and organizations to collect, analyze and share business and real-time sentient data from, and on, their mobile devices. The market will see the first version of their product next year. So far, Sentilant has won two technological innovation awards with a product that uses sensorial data collected from smartphones to help users improve driving efficiency: the Inov C Award (first place) of the Competition “Arrisca.C’2012 – Ideas, Business Plans, and Proofs of Concept”, and the second place in the PT Galp Innovation Challenge.

Streambolico

Streambolico technology provides scalable WiFi video streaming in high density scenarios, by making it possible to deliver video to 10 times more users per WiFi hotspot. Streambolico revolutionizes the video broadcast to any mobile platform using a ubiquitous new delivery channel, WiFi networks.

Users can watch their favorite TV channels in the food court, in the airport or in any other public venue using their smart devices, while fans in sport and music events can also view different cameras in their own devices. One of the co-founders was João Barros, former national director of the CMU Portugal Program, and Paulo Oliveira, a Ph.D student that spent several periods at Carnegie Mellon University.
Unbabel

Unbabel’s Customer Service Solution allows modern enterprises to understand and be understood by their customers in dozens of languages by combining human expertise and artificial intelligence (AI). Powered by AI and refined by a global community of translators, Unbabel combines the speed and scale of machine translation with the authenticity that can come only from a native speaker.

Unbabel was funded by Vasco Pedro, a graduate from CMU’s Language Technology Institute (LTI) and a CMU Portugal project post-doctoral fellow, and André Martins, CMU Portugal alumni, is the VP of Artificial Intelligence Research.

Veniam

Veniam’Works is a spin-off company of the Instituto de Telecomunicações and the Universities of Aveiro and Porto, which connects vehicles to each other and to the Internet using vehicular mesh networking technologies. Veniam designs, develops, and deploys vehicular ad-hoc networks for any type of business. Using advanced simulation software, this startup is able to deliver detailed studies on the expected quality of service, bandwidth, latency, and coverage for different cities, vehicle densities, and traffic scenarios.

Veniam is a startup company created by João Barros, faculty at the Faculdade de Engenharia of the Universidade do Porto, and Susana Sargento, faculty at the Universidade de Aveiro. Veniam’Works is Track Winner of the Building Global Innovators Venture Competition.
Virtual Traffic Lights

Virtual Traffic Lights (VTL), LLC was founded in 2010 by Prof. Ozan Tonguz of Carnegie Mellon University (CMU), along with co-founders Dr. Michel Ferreira and Dr. Luis Damas of the University of Porto, as a CMU spinoff targeting to solve some of the acute transportation problems of our times by using vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications paradigms based on the emerging Dedicated Short Range Communications (DSRC) technology at 5.9 GHz in addition to other 2G, 3G, and 4G wireless and cellular technologies.

The proprietary technology (U.S. Patent pending) developed by VTL is proven to increase the traffic flows in urban areas by 60% during rush hours which seems pretty significant and revolutionary. Such an improvement has serious implications in terms of reducing the commute time of urban workers, mitigating congestion, lessening carbon footprint of cars, increasing productivity, and supporting a greener environment. In addition, the proposed technology and the core invention of VTL will be an indispensable building block for the ongoing research efforts on autonomous driving.
The key communication objectives for the CMU Portugal program in 2018-19 included:

- Enhancing the program’s visibility, particularly in online platforms;
- Supporting new initiatives and activities;
- Promoting a strong relationship with key stakeholders and representatives of the program;
- Building a solid communication network with all stakeholders to share initiatives and increase our outreach.

To fulfill these objectives, the program has implemented a communications plan, which covered a wide spectrum of actions:

- Create a new identity and website
- Enhance and increase online activities
- Support press and other media activities
- Participate and host strategic events
In 2018, the partnership’s first concern was to work on the development of a new website and brand identity that reflects the renewal of the partnership and its goals for the future.

The coordination office, including a webmaster and a designer, worked for over 8 months on the development of a new graphic image and website. This included re-structuring the architecture of the website, rethinking its navigation, usage and cross platform support.

Simultaneously during this period, the partnership worked to improve its online visibility within the CMU Portugal community (faculty, students, alumni, industrial partners), media and a wider audience.

The opportunities used to highlight the program’s initiatives included the new mission and strategy defined for this new phase, the appointment of two new National Co-Directors, the growing number of partners involved in the program’s initiatives, the two Calls for projects launched during this period and other actions led under the education flagship such as the mobility programs and the call for the Dual-Degree Ph.Ds.

Between January 2018 and March 2019, the CMU Portugal program was mentioned in **158 articles** in the Portuguese media, had **over 50 articles** published on its website, and **1285 posts** published on social media.
### Strategy & Communication Overview

#### CMU PORTUGAL

**Communication in Numbers**

**Summary of CMU Portugal presence in the media (2018/2019)**

- **158 Articles Published in the Media**
  - 142 Online
  - 13 Printed Articles
  - 1 Video Coverage by Reuters
  - 1 Piece in TV
  - 1 Piece in Radio

### In online Platforms

#### Website (since launch in Nov. 2018)

- **53 CMU Portugal News articles**
- **30 Events Shared**
- **6 Newsletters**

#### Social Media (2018 - 2019)

- **Facebook**
  - **440 Published posts**
  - **8955 Interactions**
  - **+114k Global Reach**
  - **650 Nº of followers**

- **Twitter**
  - **712 Tweets**
  - **212 Mentions in 2019**
  - **3912 Profile Visits**
  - **1311 Nº of followers**

- **LinkedIn**
  - **133 Published posts**
  - **579 Clicks**
  - **463 Nº of followers**
To support the entrance into a new phase, the CMU Portugal Program renewed its image and created a brand-new logo and website.
The new CMU Portugal Program logotype aims to highlight the importance of the collaboration between Portugal and Carnegie Mellon University focusing on the ideas of partnership, collaboration and network. The connection of these two partners, these two "dots", will lead to new paths, research, talent development, and other innovative possibilities.

Since the main area of focus of the Program is ICT, the new branding represents technology through the use of a simplified icon inspired by networks and graphs. Furthermore, the Carnegie Mellon Portugal program’s branding keeps a strong connection to the Carnegie Mellon main brand through the use of their word mark and color palette, but still being able to have its own identity.

The logotype is the visual support of the program’s mission: placing Portugal at the forefront of innovation in key focused areas of Information and Communication Technologies (ICT) by promoting an innovation ecosystem with a tight coupling between cutting-edge research, world-class graduate education, and highly innovative companies in the data-driven economy. Therefore, the logotype should be present on all the initiatives, communications and/or products developed under the scope or funded through CMU Portugal Program.
Additionally, and aligned to the main logo, other elements were developed including:

**Secondary logotypes** for each of the program’s Initiatives and areas of activity, always aligned with the brand’s concept.

**Activities icons**

- Secondary logotypes
- New communication materials: roll ups, notebooks, pins, greeting cards, folders, pens, bags, letter paper, and more
The main goal for the new website was to improve the previous version that was implemented since the first phase and didn’t support its current vision. The strategy was to build a brand-new website aligned with the new image and able to reflect a clean and modern perspective of what the Program intends to be in its 3rd phase.

The overall goal was to create a new website:

- Easy to navigate
- With clear contents
- Efficient search engines
- Cross platform support

During the transition process in between websites there was an effort to keep the most relevant information accessible on the new version including all the media articles published since 2007. The new website was launched in November 2018 and has been since then one of the main platforms to disclose the Program’s initiatives.
Communication Activities

The Program’s communication activities are actively focused on two main areas:

Online activities

Using CMU Portugal web-based platforms including the website, which is a primary source for information concerning the Program (www.cmuportugal.org) and the Program’s social media networks:

Facebook Twitter LinkedIn YouTube

The use of web-based platforms is increasingly widespread amongst individuals and organizations giving the opportunity to potentially establish dialogue, build relationships and engage with your audience. The Program’s main goal is to establish and increase its audience through an active online engagement at these selected platforms.

Press and Media Activities

For disclosing the Program’s activities to a broader audience, the communications team from the CMU Portugal Coordination Office works closely with the National Directors and other members of the CMU Portugal community (faculty, industry partners, students and alumni etc.) towards enhancing the media output related to the Program’s initiatives and promoting it in the Media.
Web based platforms are, as previously mentioned, an essential support for the promotion and dissemination of the results achieved within the program.

Therefore, a practice was implemented on several web-based platforms:

### Website

The website is used to disclose news about Education, Research, and Innovation, as well as events, news in the media and other partner-related contents. Its contents include:

- **News articles**
  With all the information about our latest activities and initiatives;

- **Inside stories**
  Monthly features with interviews and articles with members of our community (industry partners, students and faculty) but also online articles to follow up relevant achievements (awards, papers etc.)

- **Events**
  Disclosure of all events related to the Program (Portugal and Pittsburgh).

- **Publications**
  Regular updates of all publications related to the CMU Portugal program, including those supported under CMU Portugal projects, authored by CMU Portugal Faculty, students, researchers etc.
Social media platforms

Facebook Twitter LinkedIn YouTube

The Program publishes posts every weekday on social media, on a daily basis on Facebook and usually more often on twitter. Linkedin is mainly updated to disclose information about the Program’s initiatives and announcements, and Youtube for video content.

Updates and shares on CMU Portugal Program web platforms, namely Facebook, Twitter, Linkedin and Youtube are mainly focused on:

- CMU Portugal initiatives (activities, events & CMU Portugal publications);
- Carnegie Mellon University initiatives and activities;
- Relevant information from partner Universities and companies involved with the Program;
- News and trends on ICT or other relevant topics to the community;
- Other general information that might be of relevance to CMU Portugal audience.

The Program is strongly committed in building a strong online network involving Partner Institutions such as universities, research institutions, laboratories and companies etc., that will be open to share and disclose CMU Portugal’s initiatives and activities through their online platforms. Between January 2018 and December 2019, there was an effort to improve the Program’s social media outlets which resulted in a total of 440 Facebook posts, 712 on Twitter and 133 on Linkedin.

Facebook
The Program’s Facebook page had 419 followers on February, 2019, and reached 650 on December 31, 2019, an increase of 231 followers equivalent to a 55.13% growth.

Twitter
Twitter account also raised its number of followers, with a growth of 311 followers since the beginning of 2018 for a total of 1311 followers by the end of 2019, an increase of 31.1%.

LinkedIn
LinkedIn account currently has 463 followers. For this platform, the last data available is from the 2016 Report, which registered a total of 190 followers by March 2017.

YouTube
The YouTube channel is updated with new videos related to the Program’s initiatives or from the Program’s clipping and has currently 892 subscribers.
On December 2018, the Program launched its first bi-monthly digital newsletter named “News from the Fence” to promote its initiatives, including news, events and CMU Portugal papers, distributed through electronic mail, shared on our social media networks and available on our website.

The name chosen refers to the Carnegie Mellon Campus Fence, an unofficial billboard that students use to paint with poignant messages, to advertise upcoming events or recent accomplishments.

The Program has released until the end of 2019, 6 Newsletters available here for consultation.

---

E-mail messages for specific audiences are used for announcements, invitations to events, recruitment for graduate programs, and other important information in between newsletters. Myemma online mailing platform is used for this end (https://myemma.com).

Since the launch of the website, 53 articles have been published including 11 Inside stories and interviews with CMU Portugal Stakeholders. Additionally, there were 30 events disclosed on the website related to CMU Portugal initiatives as organizer or invited participant.
Another important part of the process of communicating lays at the interface with the media. The CMU Portugal communications team works towards enhancing the Program’s visibility in the media and disclosing the Program’s activities and outcomes throughout the year.

Within this scope, a broad range of communication activities are implemented, always aligned with the strategic objective of communicating CMU research portfolio and education achievements, namely through:

**Press releases disclosure**

Since February 2018, the CMU Portugal Program launched a total number of 11 Press Releases to the Portuguese Media, 5 in 2018 and 6 in 2019.

Until 2018 the program maintained a key collaboration with LPM, a public relations agency that used to prepare and distribute the Program’s press releases to the media and established all contacts with the media. When entering the 3rd phase, this collaboration has come to an end and currently this work is done internally by the Portuguese Coordination Office.

**One-to-one negotiations:**

In addition to the Press Releases and when there is a specific topic of interest to the Media regarding the Program, efforts are made to establish strategic contacts with journalists to promote interviews, opinion articles or other media news.

Since February 2018, the Program managed to proactively promote a set of 14 interviews and news articles by reaching out directly to some targeted media to ensure the coverage of some of its latest initiatives in more detail.
Overall, the Program’s media activities resulted in more than 150 references in articles published in the Portuguese media between February 2018 and December 2019. The Internet was the main medium with 142 articles, followed by 13 press articles, 1 TV & Radio news pieces, and a Reuters media coverage.

This media presence is the result of the Program’s press releases and one-to-one negotiations which in that period covered, among other themes, the Renewal of the partnership, CMU Portugal events and the multiple calls – Ph. D. Scholarships, Visiting & Researchers Program, Call for Large Scale Projects and Exploratory Projects among others.
Events and Outreach

From January 2016 to March 2017, the CMU Portugal Program organized several events targeting different audiences, namely researchers, industry stakeholders, government bodies, entrepreneurs, students, and faculty members.

All these events were organized and implemented with the goal of bringing together the academic and industry communities involved in the Program, as well as raising awareness about the Program among new stakeholders and audiences.

The showcasing of the outcomes of the Program continues to be a strong feature of these events.

Next are highlighted the key events that occurred in 2018 and 2019, first CMU Portugal Outreach events in which the Program participated with the goal of interacting with a broad public to disclose and promote the Program’s initiatives and activities; and high profile events promoted by CMU Portugal addressed to strategic stakeholders and high profile entities including members from the Portuguese Government, Ministry, Fundação para a Ciência e Tecnologia (FCT), Carnegie Mellon University and CMU Portugal Governance among others.
Outreach and Public Events

On July 3, the CMU Portugal Program hosted a session entitled “Information and Communication Technologies: applications and challenges” at Ciência 2018, a major Science Conference organized by the Portuguese Government. The session included talks from seven researchers of the Program’s Exploratory Research Initiatives (ERIs) and addressed the main goals and results achieved by the initiatives launched by FCT through the CMU Portugal Program.

Between July 8th and 10th, the CMU Portugal Program participated at the Ciência 2019 Summit to promote its latest initiatives to the general public and present some of the research projects developed under the Program. The CMU Portugal Program hosted the session “CMU Portugal – Exploring New Research Frontiers in ICT” in which stakeholders from different areas of ICT, including representatives from Academia and Industry, shared their vision for the future. During the event, the CMU Portugal Program also held a stand to promote its initiatives to the general public and show some demonstrations of its ERIs and Exploratory projects.

On December 12, the CMU Portugal Program was at the “INCoDe 2030: 2nd Conference of the National Forum for Digital Competences” with a promotional stand. The event took place at the Lisbon Congress Center and was an opportunity to show what is being done by the Program to a broad audience and promote future initiatives.

“Look and See. Sense and Live” and “Other Portraits and Self-portraits” Exhibit took place at Fundação para a Ciência e Tecnologia (FCT) from March 25th to the beginning of May. The exhibition was developed under the Carnegie Mellon Portugal Program project SCREEN DR, led by Professor Aurélio Campilho from INESC TEC’s C-BER Center and later in Lisbon at FCT and Ciência 2019. The CMU Portugal Program was responsible for settling the Exhibition at FCT and for all the related logistics and disclosure of the event.

On December 12, the CMU Portugal Program was at the “INCoDe 2030: 2nd Conference of the National Forum for Digital Competences” with a promotional stand. The event took place at the Lisbon Congress Center and was an opportunity to show what is being done by the Program to a broad audience and promote future initiatives.

“Look and See. Sense and Live” and “Other Portraits and Self-portraits” Exhibit took place at Fundação para a Ciência e Tecnologia (FCT) from March 25th to the beginning of May. The exhibition was developed under the Carnegie Mellon Portugal Program project SCREEN DR, led by Professor Aurélio Campilho from INESC TEC’s C-BER Center and later in Lisbon at FCT and Ciência 2019. The CMU Portugal Program was responsible for settling the Exhibition at FCT and for all the related logistics and disclosure of the event.

On December 12, the CMU Portugal Program was at the “INCoDe 2030: 2nd Conference of the National Forum for Digital Competences” with a promotional stand. The event took place at the Lisbon Congress Center and was an opportunity to show what is being done by the Program to a broad audience and promote future initiatives.

“Look and See. Sense and Live” and “Other Portraits and Self-portraits” Exhibit took place at Fundação para a Ciência e Tecnologia (FCT) from March 25th to the beginning of May. The exhibition was developed under the Carnegie Mellon Portugal Program project SCREEN DR, led by Professor Aurélio Campilho from INESC TEC’s C-BER Center and later in Lisbon at FCT and Ciência 2019. The CMU Portugal Program was responsible for settling the Exhibition at FCT and for all the related logistics and disclosure of the event.
On July 10th, CMU Portugal National Co-Director, Nuno Nunes, presented at Carnegie Mellon University the new Call for Exploratory Research Programs (ERPs) and Phase III Initiatives. Professor Nunes discussed the timeline of the ERP Call, the applicable research areas, and connecting with collaborators in Portugal and gave an overview of the recently closed Large-scale Collaborative Research Project Call, the Dual-Degree Ph.D. Programs, the Mobility Programs, and the Executive Program Initiative.

The CMU Portugal Program supported the visit of Yvonne Rogers from the University College London and Jodi Forlizzi from Carnegie Mellon University to Portugal, to give a Lecture on User Design at Técnico. These two brilliant women who lead the top Human-Computer Interaction (HCI) Departments in the world of Computer Science gave a talk entitled "Beyond User-Centered Design" in front of a full audience at Instituto Superior Técnico on December 18th.

Lenore and Manuel Blum, both Professors at Carnegie Mellon School of Computer Science, visited for the first time Portugal under the CMU Portugal Program, to participate in two seminars on gender Balance and for the "duet-talk" "Towards a Conscious AI – A computer architecture inspired by cognitive neuroscience" in Lisbon (Instituto Superior Técnico) and Porto (INESC TEC and Faculdade de Ciências da Universidade do Porto).

The CMU Portugal Program hosted a Welcome Reception in Pittsburgh to connect students living in Pittsburgh, CMU Faculty members and Visiting Faculty from Portugal during their stay at CMU.

The CMU Portugal Program held a Networking event at CMU for CMU Portugal affiliates on October 20th.

CMU Portugal Seminar “Why are we still talking about Gender Balance in STEM?” and Distinguished Lecture “Towards a Conscious AI – A computer architecture inspired by cognitive neuroscience”

- 23 October at Instituto Superior Técnico, Universidade de Lisboa
- 25 October at FCUP, Universidade do Porto
February 15th
Official Renewal Ceremony

The CMU Portugal Program was renewed for another decade in an agreement signed between Carnegie Mellon University (CMU) and the Portuguese Government at the ceremony “GoPortugal Global Science and Technology Partnerships Portugal,” which took place at CEiiA in Porto. During the ceremony the Program also signed cooperation agreements with new Industrial affiliated partners for the 3rd phase of the partnership. The agreement was signed by FCT President Paulo Ferrão and by CMU Interim President Farnam Jahanian, officially launching a new phase of the CMU Portugal Program.

February 16th
Carnegie Mellon Portugal Technical Workshops at Porto

The CMU Portugal Program organized a series of technical workshops at UPTEC in Porto, open to the scientific community and led by Portuguese and CMU researchers. The six workshops were held simultaneously and had over 140 attendees, bringing together not only faculty from Carnegie Mellon University and Portuguese universities, but also researchers and engineers from the many companies that are committed to participating in the third phase of the program.
The Carnegie Mellon Portugal Program organized its annual Project Review Meeting at Fundação para a Ciência e Tecnologia on March 25 and 26, to conduct mid-term and final project evaluations held by an External Review Committee.

The Carnegie Mellon Portugal Program held its annual Board of Directors (BoD) Meeting at Fundação para a Ciência e Tecnologia (FCT) Headquarters in Lisbon on September 20th. The BoD is part of CMU Portugal’s governing structure and is responsible for policy oversight and discussion of the CMU Portugal Program plan of activities.

A Portuguese delegation visited Carnegie Mellon University on December 12 and 13 for 2 days of networking with peers at CMU to strengthen cooperation initiatives for the third phase of the program. The delegation was composed of five CMU Portugal Scientific Directors from Portuguese Universities and by CMU Portugal Executive Director in Portugal and its Head of Education. During the visit, organized by the CMU Portugal coordination office at CMU, the Portuguese committee had an opportunity to connect with CMU faculty leaders of strategic research areas of the CMU Portugal Program, heads of department and doctoral programs directors and managers of the CMU Portugal Dual-Degree programs.

The Minister of Science, Technology and Higher Education, Manuel Heitor, visited on February 1st Carnegie Mellon University (CMU) on an official visit, along with a delegation of 15 people including the President of Fundação para a Ciência e Tecnologia (FCT), Paulo Ferrão; Carnegie Mellon Portugal Program National Co-Director, Nuno Nunes; representatives of Industry, including REN and Altice; and faculty members of several Portuguese universities and research centers.

The visit was focused on strengthening the cooperation in ICT between the Portuguese Government and CMU through the Carnegie Mellon Portugal Program (CMU Portugal), by promoting strategic networking meetings among the Portuguese delegation and research groups, faculty, and leaders of CMU. The visit was hosted by the Director at CMU of the CMU Portugal Program José Moura and included discussions with James Garrett, CMU's Provost, and Farnam Jahanian, CMU's President.