A technology that can hear cancer cells

A multidisciplinary research team from IT (Henrique Leonel Gomes, Carmo Medeiros, Ana Mestre, and Pedro Inácio), together with teams from the Centre for Biomedical Research of the University of the Algarve and the Max Planck Institute, in Mainz-Germany, has developed electronic components that can measure the electric activity of nervous system cells that until now had gone unnoticed. The research was recently published in *Science Advances* (an open access-journal of the Science publishing group). According to this journal, the findings have a high attention score compared to outputs of the same age (among the top 5%). The study is raising new questions regarding the possible electrical signaling produced by brain tumors and their impact in the brain. These findings were only possible due to the electronic components able to detect ultra-weak bioelectrical signals. The new electronic technology was tested in cells from mice brains with astroglioma type tumors. These tumor cells derive from astrocytes, nervous system cells that give functional, metabolic and structural support to neurons. This new developed technology allows measuring discrete electrical signals, (below one micro-volt) that are produced by cultures of cells. Until now, the available technology was only capable of measuring signals above 10 micro-volts. Another advantage of these new electronic components is that they allow examining the cells throughout the culture process directly from the electronic chips that detect the electrical signals. These finding may pave the way for future brain tumor therapies.

Editorial

Multidisciplinary is a word often shout but little used by many in the field of science and technology. Personally I have often been asked why should IT dwell into fields other than telecommunications, such as biosciences. The need for inroads into Mathematics or Physics hardly ever causes raised eyebrows but biosciences invariably do. Yet telecommunications to build and operate everyday devices (such as the cell phone) and services (such as the Internet) use subjects such as number theory, Galois fields and quantum mechanics, subjects that 50 years ago were considered to be exotic and of little use.

For everyday work telecommunications make use of techniques such as advanced electromagnetics, signal recovery and identification in noise, information theory, signal processing, image coding and reconstruction that are (or will be) of immense value in biosciences.

When admiring the great successes of modern medicine, namely in the field of diagnostics and surgery, we should recall that most were made possible by techniques developed by teams including electrical, electronic and telecommunication scientists.

Joint projects are certainly not easy to set up and to fund but they are a must if we want to play our best role to society.

Carlos Salema
Light emitting diodes (LEDs) are becoming increasingly ubiquitous in our surroundings, mainly due to their long operational lifetime and high energy efficiency. They can be found in illumination appliances, phones, TVs, advertising panels, dashboards, traffic signals, etc. Also LEDs are capable of switching their light intensity at a rate that is imperceptible to the human eye. This property has been used for dimming purposes but can also be used for the opportunistic deployment of value added services based on Visible Light Communications (VLC). Project VLCLighting was an internally financed research project on VLC, aiming at the exploitation of VLC concepts, for broadcast services, in lighting infrastructures. It was developed by the Integrated Circuits and Mobile Network groups in Instituto de Telecomunicações, Aveiro site. State-of-the-art VLC demonstrators have proven to achieve very high data-rate applications, but are mostly based in laboratory equipment, off-line processing units, and non-illumination grade LEDs. The main goal of this project was to develop a real-time high-speed VLC link demonstrator, based upon illumination grade LEDs, and built with a globally asynchronous locally synchronous architecture. This modular approach eases the collaboration with other groups with interest in this field, offering the academic community a real-time test bed to evaluate the performance of different modules, algorithms and optical front-ends. This collaboration has already been established with two research teams, one at Brno University of Technology, Czech Republic, and one at Northumbria University at Newcastle, UK.

Ongoing work includes the development of new front-ends to extend the LED driver bandwidth and the integration of real-time video broadcasting services.
Looking beyond with Earth’s great green eye

IT, together with other academic and industrial partners, has been involved in the 6 million Euros European project Biostirling-4SKA, developing a solar power generation system that will be scaled to provide power to the Square Kilometre Array - SKA, which will be the world’s largest radio-telescope.

SKA will be built in remote areas of South Africa and Australia, making it difficult to access an electric power network. Needing 24/7 energy supply independently of weather conditions and supporting different power loads, SKA’s location in latitudes with high solar irradiance makes solar-energy an option that may contribute to a (near) zero carbon footprint for the next generation of telescopes. The dish Stirling Systems have proven to be the most efficient of any solar power generation system, a kind of glass satellite dishes that convert direct solar radiation into electric energy.

During the last months of 2016, a SKA receiver prototype and the Biostirling-4SKA power system have been tested in Herdade da Contenda, in Moura, Alentejo. Moura was chosen as a test site for being one of the only places in Europe with climate and geographical conditions similar to those in South Africa and Australia, where SKA is going to be built. With 2,500 satellite dishes and 250 stations extending over an area of 3,000 km, it is expected that the SKA will be ready to operate by 2025, performing high angular resolution surveys up to a million times faster than current leading radio interferometers.

The synergies between the SKA and project Biostirling-4SKA are undoubtedly a great example of the social impact of both renewable energies and potential astronomical discoveries, looking beyond further than we ever did and greener than we ever were.

Mónica Figueiredo

Newsflash

Mário Figueiredo among the Most Cited Researchers in ARWU

Mário Figueiredo is one of the five Portuguese researchers to appear in the Most Cited Researchers (MCR) list, built by the Shanghai Academic Ranking of World Universities (ARWU), which is one of the most influential and widely observed rankings of the world’s research activities.

As Mário Figueiredo explained to us, “The number of researchers of each university appearing in this list is used by ARWU as one of the measures of academic impact, based on which the university rankings are obtained. Consequently, appearing in this list is very important for the visibility and prestige of the University of Lisbon, in addition to being a motive of pride for the persons in the list”.

IT researchers win the CMU Portugal entrepreneurial program

Carlos Ribeiro and Eduardo Castaneda, both researchers from the Mobile Networks group of IT in Aveiro were one of the winning teams of the Carnegie Mellon Portugal inRes program, short for “Entrepreneurship in Residence”.

The IT researchers built a business model for a start-up to design advanced wireless links targeted at the professional UAV/UGV segments. The wireless links are tailored to meet these customer’s needs and push the boundaries of what is currently available on the market to enable new real-time data-hungry applications requiring tens of Mbps. The inRes immersion period in USA enabled the researchers to validate the market need and get an in-depth knowledge of the US customer’s requirements.
Latest concluded PhDs hosted by IT

Lino Ferreira

Methods for Flexible Representation and Coding of 2D and 3D Visual Information

PhD in Electronics and Computer Engineering, University of Coimbra, May 2016, supervised by Luís Cruz and Pedro Assunção. This thesis describes the results of the development of 3D visual saliency estimation methods and their applications to video retargeting, 3D and 2D video summarization methods. It also proposes several flexible video coding algorithms based on spatial and temporal scalability able to encode video summaries and video with predefined regions of interest. Lino is a Professor at the Polytechnic Institute of Leiria.

Cláudia Silvestre

Model and Feature Selection for Categorical Mixture Models

PhD in Quantitative Methods, ISCTE-IUL, May 2015, supervised by Mário Figueiredo and Margarida Cardoso. Approaches to identify the number of clusters and select a subset of variables don't apply for categorical data. We aimed to find the number of clusters on the data and to identify a subset of variables for clustering. We assume the categorical data arise from a mixture of multinomial distributions and used a minimum message length criterion to choose a parsimonious model to describe the data. Cláudia is a Professor at the Escola Superior de Comunicação Social of Instituto Politécnico de Lisboa.

Luís Lucas

Predictive Coding Algorithms for Lossy Image and Video Compression

PhD in Electrical Engineering, IST, Federal University of Rio de Janeiro/Polytechnic Institute of Leiria, January 2016, supervised by Eduardo da Silva, Sérgio Faria and Nuno Rodrigues. The thesis investigates efficient intra-prediction techniques for current state-of-the-art image and video compression algorithms. Several prediction methods were proposed to reduce the spatial redundancy in 2D and 3D video signals, using several compression algorithms based on different coding paradigms. Luís is a project engineer at Critical Software, Coimbra, Portugal.

Thaísa Leal da Silva

Contributions to reduce the complexity in the intra coding of the HEVC norm and its 3D-HEVC extension

PhD in Electronics and Computer Engineering, University of Coimbra, June 2015, supervised by Luís Cruz and Luciano Agostini. On this thesis we have developed fast algorithms for the HEVC intra mode decision, inter-view prediction of coding tree decision depth, intra coding with inter-view mode prediction, intra coding of depth maps, and intra coding of texture and depth of the 3D-HEVC. Thaísa is currently a Professor at IMED - Meridional Faculty, in Passo Fundo, Brasil.

Where are you now?

Hao Hongxing

I did my Ph.D. research at Instituto de Telecomunicações from Nov. 2011 to Oct. 2013. under the supervision of Professor Jose M. Bioucas-Dias. I spent the whole two years on the topic of interferometric phase estimation via sparse coding in the complex domain. During this period, I addressed interferometric phase image estimation problem. The new sparse-coding-based approach to interferometric phase estimation, termed the SpInPHASE, was proposed with the help of Professor Bioucas. In SpInPHASE, we reformulated the true estimation problem as a sparse regression in the complex domain. Following the standard procedure in patch-based image restoration, the image was partitioned into small overlapping square patches, and the vector corresponding to each patch was modeled as a sparse linear combination of vectors taken from a set called dictionary. Aiming at optimal noise removing capabilities, the dictionary was learned from the data that it represented via matrix factorization with sparsity constraints on the code. I also attended two courses in IT, Inverse Problems in Imaging by Professor Bioucas and Nonlinear optimization by Professor João Xavier. With the supervision of Professor Bioucas, IT provided me a chance to finish my research and I have learnt much more than doing my research. I also got the meticulous scholarship from Professor Bioucas and the conditions to enter the research field of interferometric phase image estimation during my study in IT. After my Ph. D. in 2014, I was offered a research position in Equipment Academy in Beijing, China. I continued my research in phase denoising by the complex valued dictionary learned from the group sparsity vectors and the research of training multiresolution complex valued dictionaries. Actually, all of my researches now are based on my gains in IT. No words can express my grateful thanks to IT. I will never forget IT and Professor Bioucas because they spent too much on me.