Solving tomorrow, today

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Symposium on BIOENGINEERING

8th and 9th April 2017
FEUP, Portugal

Dear participant of the 8th Symposium on Bioengineering,

Welcome to the **8th Symposium on Bioengineering**, an event whose main purpose is the most traditional, yet the most innovative goal: to present to our academic community the most recent and innovative projects with biomedical and biological applications on issues of our modern society. Our slogan is **Solving Tomorrow, Today**, and we intend to accomplish that mission once again this year.

As usual, both national and international speakers of exceptional quality, not only from the Academia but also from the Entrepreneurial world, will be present at this Symposium - the largest student-organised Bioengineering event in Portugal, taking into account previous editions attendance and success. By encouraging communication and knowledge sharing among students, academics, industry and start-ups in an event which comprises Biological/Biomedical Engineering and Molecular Biotechnology, we aim to better portray the current state of Bioengineering, particularly in the Portuguese scientific scenery.

This year, we focus not only on specific issues for each area, but also on the convergence between all three major branches of Bioengineering. In keeping with the great diversity which is associated with Bioengineering, this programme includes two very distinct panels specific to each one of the three branches of the course: Biomedical Engineering, Biological Engineering and Molecular Biotechnology. In addition, two other panels were designed to be as transversal as possible, so as to portray the interdisciplinarity of several areas to which Bioengineering has yet to contribute significantly.

Regarding **Biological Engineering**, the program includes talks on marine biotechnology and solutions inspired by the sea; white biotechnology will also be addressed by showing the distinct possibilities regarding the application of microorganisms in a productive way.
Concerning **Biomedical Engineering**, the Symposium intends to show the innovations on assistive technology and biomechanics, as well as in big data analysis and modelling systems based on human behaviour and emotions.
Apropos of **Molecular Biotechnology**, the program focuses on biohacking and gene editing; in addition, the new models that are being used to study organs and systems, such as organ on a chip and organoids will also be addressed.

The Symposium agenda includes a panel on **Pharmaceutics**, going from drug development/production to its delivery, and **Nanotechnology**, an emerging area with increasingly various and valuable applications. A panel on **Bioentrepreneurship** is included in

order to show the testimonies of entrepreneurs and understand the evolution of idea-to-company in each case. Lastly, **MIB/MEB™** aims to show the work developed by students who recently finished their Master's Degree on Bioengineering or Biomedical Engineering, in FEUP/ICBAS. Our agenda is completed with a **Poster Contest**, for the exposition of work being developed by students and researchers with any relevance in the multidisciplinarity of Bioengineering.

The work of researchers from different countries will contribute to this 8th edition of the Symposium in accomplishing a solid and up-to-date event, broadening the horizons and spiking the curiosity of future Bioengineers. This is, after all, the apogee of our vision, Solving Tomorrow, Today. If Bioengineering is a field of unlimited and yet-to-be-imagined applications, then Portugal has the talented and hard-working people to, once again, 500 years later, set sail from the safe harbour and venture further afield in this world of discoveries. Communication and partnership with different countries, projects and mindsets are key for a new chapter in the convergence of Life Sciences and Technology. Above all, one must know more to further idealize and concretize.

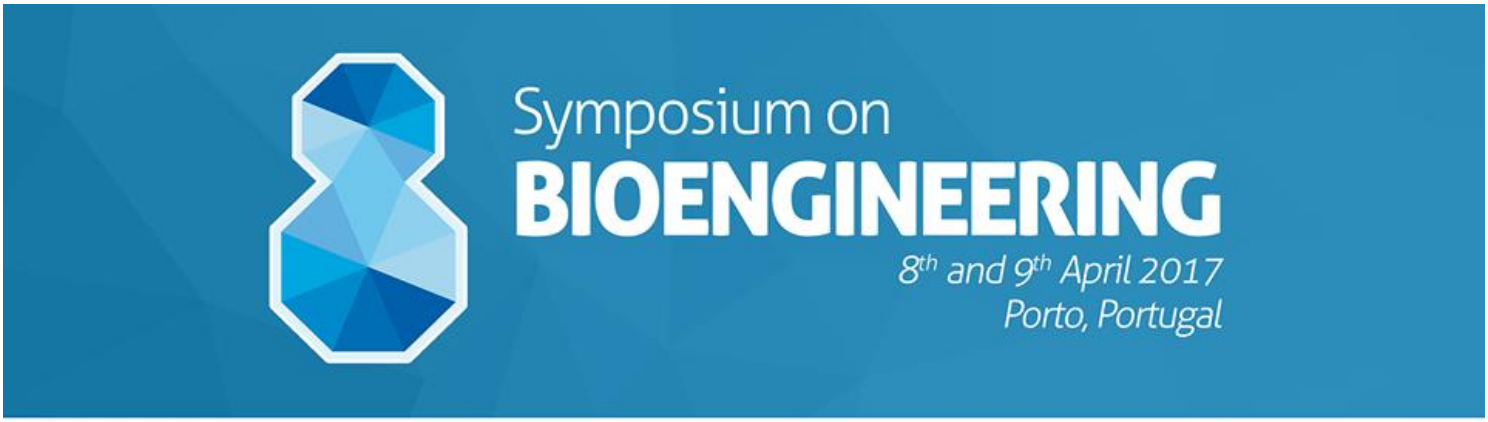
The Organizing Committee

Associação Portuguesa Epidermólise Bolhosa (DEBRA Portugal) is the national, non-profit association against epidermolysis bullosa, a rare and painful skin illness that most have never even heard of.

Its goal is to improve the lives of those who carry this burden on their shoulders, and to fight it by promoting public awareness and raising funds for scientific research and better care.

Workshops:
15h - Hands-On Workshop on Bioinformatics (Pedro Ferreira - i3S)
15h30 - BITalino Workshop (Hugo Silva - Plux)
16h45 - Design Thinking (Miguel Amador - Startup Braga)
19h - Health 2.0 MeetUP

Speed Dating



Day 1 - 8th April

10h30

Coffee Break + Speed Dating I

Ana Matos | MIB/MEB™
Ana Luísa Torres | MIB/MEB™
Hugo Paredes | Assistive technologies for the blind

16h00

Coffee Break + Speed Dating II

José Teixeira | Developments in production of 2nd generation bioethanol
Paulo Freitas| Detection of neuronal magnetic fields with integrated microelectrodes
Inês Cardoso Pereira | New catalysts for the removal of drugs

18h30

Speed Dating III

Pedro Baptista | Liver Organoids for Recapitulation of Organogenesis
Thomas Landrain | Exploring the dark matter of Science
Marco Capogrosso | A computational framework for the design of spinal neuroprosthetics

Day 2 - 9th April

10h15

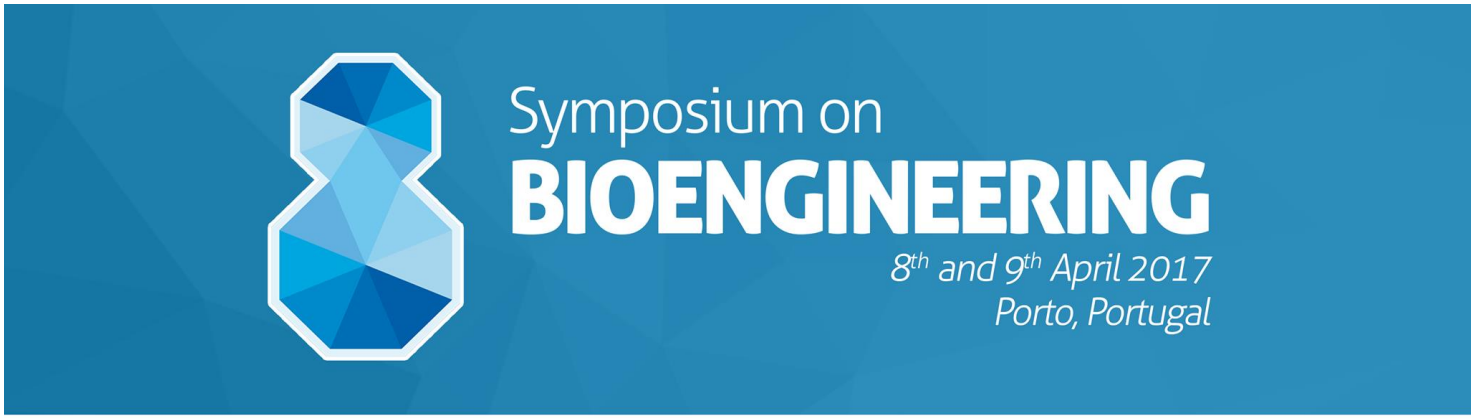
Coffee Break + Speed Dating IV

Patrícia Figueiredo | Multimodal Brain Imaging
Emanuel Sousa | Robots as Socially Intelligent Assistants
João Ribas | Vascular aging-on-a-chip

15h45

Coffee Break + Speed Dating V

Vitor Vasconcelos | Cyanobacteria technological applications
Gabriel Monteiro | Plasmid biopharmaceuticals
Carmen Freire | Bacterial nanocellulose membranes as promising drug delivery systems
João Pedro Ribeiro | How can technology make a dent in Orthopaedics



Day 1 - 8th April

10h30

Coffee Break + Speed Dating I

Francisco Mendonça | Biomedical Engineering

16h00

Coffee Break + Speed Dating II

Filomena Freitas | Production of microbial biopolymers
Garabed Antranikian | Extremophiles for a sustainable Biobased Industry

18h30

Speed Dating III

José Bessa | The use of CRISPR to crack the transcriptional regulatory code of the zebrafish
Juan Gallo | Magnetic solid lipid nanocomposites

Day 2 - 9th April

10h15

Coffee Break + Speed Dating IV

Brígida Faria | (Big) Data Analysis and its opportunities heathcare applications
Filipe Cardoso | The creation of a medtech company the Magnomics case

15h45

Coffee Break + Speed Dating V

Luísa Gouveia | All Colors of Microalgae
Miguel Amador | Presenting Startup Braga

Social Dinner will be at Adega Figueiroa, a glamourous and pleasant restaurant right in the centre of the great city of Porto. Who will resist the opportunity to connect with speakers and other attendees, over the best appetizers, dishes and desserts, and a nice glass of Port wine? Don't miss it!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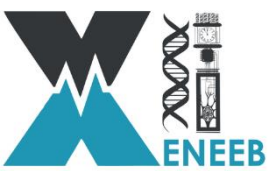


This symposium was financially supported by the project POCI-01- 0145-FEDER- 006939 (Laboratory for Process Engineering, Environment, Biotechnology and Energy – UID/EQU/00511/2013) funded by the European Regional Development Fund (ERDF), through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds, through FCT - Fundação para a Ciência e a Tecnologia.

ORGANIZING COMMITTEE

NEB-FEUP/ICBAS
núcleo de estudantes de bioengenharia

The Bioengineering Student's Group (Núcleo de Estudantes de Bioengenharia - FEUP/ICBAS) was created on the 6th November, 2013. It has been entirely running by students taking their MSc on Bioengineering, a joint programme between two Faculties of the University of Porto: the Faculty of Engineering and the Abel Salazar Institute of Biomedical Sciences. The group aims at the organization of events and activities for the Bioengineering student community and the establishment of a communication network involving other student groups, as well as companies, research institutes, universities and other scientific organizations, both national and international. One of the main goals of the group is the promotion of the three specialised branches within the degree: Biomedical Engineering, Biological Engineering and Molecular Biotechnology.

The group is legally recognized as a Non-Profit Organization.

Scientific Committee

Contributing in the creation of this rich panel of speakers is our **Scientific Committee**, whose members have a profoundly distinct academic background, in such a way that their contributions most certainly provide for the interdisciplinarity desired for this event. Relying on the conjunction of researchers and professors with different experiences and personalities, no other outcome ought to be expected except a strongly cohesive, dynamic and inclusive programme.

Professor André Pereira
Nanotechnology
Assistant Professor at FCUP.

Professor Carlos Conde
Cell Division and Genomic Stability
Invited Assistant Professor at ICBAS, Researcher at i3S.

Professor Inês Gonçalves
Nanobiomaterials for Localised Therapy
Invited Assistant Professor at DEMM-FEUP and ICBAS, Researcher at i3S.

Professor Joaquim Mendes
Automation, Instruments, and Control
Assistant Professor at DEMec-FEUP, Researcher at UISPA, Member of LAETA.

Professor Luís Melo
Biofilms
Full Professor at DEQ-FEUP, Member of LEPABE.

Professor Luís Vieira
Natural Product Chemistry
Assistant Professor at ICBAS.

Professor Manuel Simões
Biofilms
Assistant Professor at DEQ-FEUP, Member of LEPABE.

Professor Miguel Coimbra
Healthcare Interactive Systems
Assistant Professor at FCUP and FMUP, Member of IEEE Portugal.

Professor Nuno Azevedo
Microbiological Detection
Professor and Researcher at DEQ-FEUP, Member of LEPABE.

PROGRAM

8th April, 2016

9:00 Opening session

9:45 **MIB/MEB™**
Ana Matos: Biological Engineering
Ana Luísa Torres: Molecular Biotechnology
Francisco Mendonça: Biomedical Engineering
Luís Melo *Moderator*

10:30 Coffee Break

11:00 **Hybrid Human**
Marco Capogrosso: A computational framework for the design of spinal neuroprosthetics
Hugo Paredes: Assistive technologies for the blind
Paulo Flores: Recent developments in Biomechanics and Biomedical Devices
Joaquim Gabriel *Moderator*

12:30 Lunch

14:00 **Industrial Biotechnology: Engineering with Life**
Garabed Antranikian: Extremophiles for a Sustainable Biobased Industry
Filomena Freitas: Production of microbial biopolymers
José A. Teixeira: Developments in the production of 2nd generation bioethanol
Nuno Azevedo *Moderator*

15:30 Poster Pitch

16:00 Coffee Break + Poster Walk

16:30 **Engineering at $x10^{-9}$**
Paulo Freitas: Detection of neuronal magnetic fields with integrated microelectrodes
Inês Cardoso Pereira: New catalysts for the removal of drugs
Juan Gallo: Magnetic solid lipid nanocomposites
André Pereira *Moderator*

17:30 **Speed-ticketing Science Evolution**
Thomas Landrain: Biohacking: when biotech breaks free
José Bessa: The use of CRISPR to crack the transcriptional regulatory code of the zebrafish.
Carla Sá Couto: DEBRA Portugal
Carlos Conde & Júlio Santos *Moderators*

20:00 **Social Dinner**

9th April, 2016

9:00 **Engineering: the Keymaster of the Human Body**
Emanuel Sousa: Robots as Socially Intelligent Assistants
Patrícia Figueiredo: Multimodal Brain Imaging
Brígida Faria: (Big) Data Analysis and its Opportunities: Healthcare Applications
Pedro Amorim *Moderator*

10:15 Coffee Break

10:45 **Biotech Lab 2.0**
Pedro Baptista: Liver Organoids for Recapitulation of Organogenesis
Lino Ferreira: Human tissues grown in a dish
João Ribas: Vascular aging-on-a-chip
Inês Gonçalves *Moderator*

12:15 Lunch

13:45 **Blue Biotechnology: Sea Solutions**
Luísa Gouveia: Blue Biotechnology: All Colours of Microalgae
Vitor Vasconcelos: Cyanobacteria technological applications
Jorge Temido: BUGGYPOWER microalgae biorefinery State-of-the Art: The Production Unit of Porto Santo, Madeira
Manuel Simões *Moderator*

14:45 **Drugs: from Scratch to Hatch**
Maria João Ramos: Computational Strategies in Drug Discovery
Gabriel Monteiro: Plasmid biopharmaceuticals
Carmen Freire: Bacterial nanocellulose membranes as promising drug delivery systems
Filipe Mergulhão *Moderator*

15:45 Coffee Break

16:15 **A tour through Bioentrepreneurship**
Miguel Amador: Presenting Startup-Braga
João Pedro Ribeiro: How can technology make a dent in Orthopaedics
Filipe Cardoso: The creation of a medtech company: the Magnomics case
José Amorim de Sousa: OATVITA: a pre-fermented oat cream for the food industry
Miguel Amador *Moderator*

17:15 Announcement of Poster Contest winners

17:30 Closing Session

Engineering at $x10^{-9}$

Paulo Freitas

P.P. Freitas did his undergraduate studies at Univ. of Porto, "Licenciatura in Physics" 1981, got his PhD in physics from Carnegie Mellon University, Pittsburgh in 1986, followed by a postdoctoral appointment at IBM T.J. Watson Research Centre, Yorktown Heights. In 1988, he joined INESC where he created the Solid-State Technology Group, later INESC Microsystems and Nanotechnology, and in 1990 joined IST-Lisbon, where he is presently full professor of Physics (on leave at INL). Since 2008 he is Deputy Director General of the International Iberian Nanotechnology Laboratory (INL). Research activity focuses on spintronic and applications in sensing, memory, biological and biomedical applications. In the biomedical area, applications cover DNA and protein biochips, integrated cell cytometers, neuroelectronic. He has authored/co-authored over 400 research articles, advised 18 PhD students, and participated in the recent formation of start-up using INESC MN magneto resistive biochip technology.

"Detection of neuronal magnetic fields with integrated microelectrodes"

Recent results on the measurement of neuronal magnetic and electrical signals recorded with inserted microelectrodes in the visual cortex of cats are reported. The results come from a collaboration of partners within the FP7 Magnetrodes project involving CEA/SPEC/CNRS-Paris, INESC MN, ESI–Frankfurt. Our magnetic microelectrodes (magnetrodes) comprise a magnetic field sensor (spin valve, tunnel junction) microfabricated into a Si microneedle and can reach detection limits of the order of few nT/sqrt Hz, at 1Hz. Results are reported from in vivo experiments where microneedles are inserted (about 1mm) in the visual cortex of anesthetized cats. The visual cortex is excited with a light pattern (100ms or 500ms pulses) in one eye. The results are obtained averaging over 1000 stimuli. The detection electronics involves DC detection, or AC detection and demodulation. The strength of the recorded channels is of several nT, and offers local information on the direction of current flow. The magnetic signals are compared with electrical signals coming either from the Tungsten electrode, or from impedance electrodes on the needle.

Juan Gallo

Juan Gallo received a degree in Biochemistry (2004) from the University of Salamanca, and a degree in Chemistry from the University of Valladolid (2005). He obtained his PhD in Chemistry (2011) from the University of the Basque Country working at the laboratory of glyconanotechnology (Prof. Penades) at CICbiomaGUNE on the preparation of magnetic nanoparticles and quantum dots for biomedical applications. In 2011, he moved to the Comprehensive Cancer Imaging Centre at Imperial College London as Research Associate under the supervision of Prof. Long and Prof. Aboagye. There, he had the opportunity to work on the development of nanoparticle-based probes for the diagnosis of cancer through different molecular imaging techniques such as MRI, PET-CT, optical imaging, and ultrasound, from the chemical laboratory bench to the in vivo assessment phase. Since 2015, he is a CoFound Research Fellow at the International Iberian Nanotechnology Laboratory (INL) in Braga. Here, within the Advanced (magnetic) Theragnostic Nanostructures (AmTheNa) Lab he works on theragnostic (therapy plus diagnosis) applications of nanoparticles. His current research interests focus on the preparation, functionalisation and validation of responsive molecular imaging probes (magnetic, paramagnetic, optical) and the combination of imaging agents and therapeutic effectors. He has published over 20 research papers in leading international peer-reviewed journals, two book chapters, and has filed two patent applications (one granted, one pending).

"Magnetic Solid Lipid Nanocomposites as magnetic hyperthermia induced drug delivery vehicles and ultra-high MRI contrast enhancers"

Magnetic hybrid nanocomposites have opened new perspectives in biomedical and environmental applications. Solid lipid nanoparticles (SLNs) are interesting members of this family due to their biocompatibility, low toxicity and ability to influence the delivery of pharmacological agents. Hybrid organic-inorganic SLNs are being explored to synergistically combine the modified release provided by the lipidic part and the intrinsic physico-chemical properties from the inorganic counterpart. In this context, we present the preparation of drug loaded magnetic solid lipid nanocomposites (mSLNs) showing good multifunctional performance as ultra-high T2-contrast agents and heat generating sources in magnetic resonance imaging (MRI) and magnetic hyperthermia (MH), respectively.

An emulsion method was employed to prepare mSLNs containing different concentration of magnetite (Fe3O4) nanoparticles. Successful incorporation of the magnetic nanoparticles was confirmed by transmission electron microscopy (TEM). mSLNs showed an interesting behavior in MRI, with ultra-high transversal relaxivity (r2) that clearly translated into dark contrast effects. Simultaneously, mSLNs were tested as vehicles for the delivery of an anticancer drug and its release profile was assessed under the application of MH. Results show that the delivery profile can be externally controlled through MH protocols. In vitro results will also be shown and discussed.

Inês Cardoso Pereira

Inês Cardoso Pereira did her BSc in Applied Chemistry at Universidade Nova de Lisboa. She did her PhD in Oxford, with a work on the biosynthesis of cephalosporins and returned to Portugal for a Post-Doc at ITQB NOVA, studying metalloproteins. She is currently a Principal Investigator at this institute, where she leads a research group dedicated to studying anaerobic microorganisms, their exploitation (or their respective enzymes) for biotechnological applications. Inês Cardoso Pereira has authored 91 scientific articles (up to January 2017) and she is Editor of 4 international journals. Currently, she is also sub-director of ITQB NOVA.

"New catalysts for the removal of drugs"

The environmental contamination by pharmaceutical products is nowadays a serious problem at a global scale. The current technology at sewage treatment plants does not allow the removal of these compounds, so that the development of new processes which lead to the degradation and elimination of such pharmaceuticals is necessary. In this work, biocatalysts based on palladium and platinum metallic nanoparticles produced by anaerobic microorganisms have been investigated for the reduction of three pharmaceutical compounds: 17β-estradiol, sulfamethoxazole and ciprofloxacin. The results show that the platinum nanoparticles have a higher catalytic activity in the removal of these compounds, causing, for example, a significant reduction in the estrogenic activity of the products resulting from the treatment of 17β-estradiol. Studies are being carried out to develop new bioprocesses based on these nanocatalysts for the removal of antibiotics and endocrine disruptors.

Session moderator

André Pereira

André Pereira is currently an Assistant Professor in the Department of Physics and Astronomy of the Faculty of Sciences of the University of Porto, Assistant Researcher at the Institute of Material Physics of the University of Porto (IFIMUP) and a visiting academic member of the Imperial College of London, UK.

His Research areas are related with development of multifunctional nanomaterials and innovative micro/nanodevices for applications on Energy & Nanomedicine.

Drugs: from scratch to hatch

Carmen Freire

Carmen Freire studied Chemistry in the University of Aveiro (UA) (degree in Chemistry in 1998). Then, in 2003 she has got a PhD degree in Chemistry, also by the UA. And, in the period of 2003-2005 she had a post-doc fellow position in the Department of Chemistry of UA and in the École Française de Papeterie et des Industries Graphiques (presently Pagora) (Institute Polytechnique de Greboble). In 2006, she became a staff member of CICECO-Aveiro Institute of Materials as Auxiliary researcher and since June 2013 as Principal Researcher (Line Biorefineries and Bio-based Materials). Her research interests are centred on production and applications of biogenic nanofibers (bacterial nanocellulose and protein fibrils (amyloid fibrils)); new functional biocomposites and paper materials; nanostructured bio-based materials for biomedical applications (wound healing and drug delivery) and active packaging; design of hybrid materials based on biopolymers and inorganic nanophases (theragnostic systems, catalysis and conducting materials); and isolation, characterization and chemical transformations of bioactive natural compounds (including biopolymers).

"Bacterial nanocellulose membranes as promising drug delivery systems"

Bacterial nanocellulose (BNC) is an extremely pure form of cellulose produced by several non-pathogenic bacteria, which, due to its unique properties, such as high purity, water-holding capacity, three-dimensional nonfibrillar network, high mechanical strength, biodegradability and biocompatibility, shows a great potential as nanomaterial in a wide range of high-tech domains including biomedical applications, and most notably in controlled drug-delivery systems. This talk intends to highlight major aspects related with the production, properties and applications of BNC, with particular focus on applications of BNC membranes in topical drug-delivery systems, using either native BNC or composite materials thereof.

Gabriel Monteiro

Gabriel A. Monteiro has a graduation in Biology (1988) from University of Coimbra, a master in Biotechnology (1991) from Instituto Superior Técnico and a PhD in Biotechnology (1998) from Instituto Superior Técnico. Currently, he is an associate professor at Instituto Superior Técnico. He is (co)author of 80 articles in per-reviewed international journals, which received >1700 citations (h-index 20, Scopus ID 22956211700). In addition to these publications, he (co)authored 36 articles in non-ISI journals (book chapters, Proceedings, etc.). Currently, his research is focused on the design and manufacturing of plasmid and minicircles biopharmaceuticals, to be used as DNA vaccines and gene therapy vectors for transient cell modification. During 2016-17 he teaches at Técnico the courses of Biomolecular Engineering, Cell and Tissue Engineering, Gene Therapy.

"Plasmid biopharmaceuticals"

Plasmids are essential molecular tools on life science research and biotechnology industry for the production of pharmaceutical proteins, antibodies, enzymes, etc. Besides, plasmids are per se useful biopharmaceuticals in the context of gene therapy and DNA vaccination interventions.

This talk focus on the development of high-producer cell systems able to produce higher amounts of high-quality plasmids and on the design and production of safer plasmids with higher transfection efficiency and tunable expression.

Maria João Ramos

Maria João Ramos did her first degree in Chemistry at the Faculty of Sciences, University of Porto, Portugal. This was followed by her Ph.D. in Muon research at both the University of Glasgow, UK, and the then Swiss Institute for Nuclear Research (SIN) in Villigen, Switzerland. Subsequently she did a post-doc in Molecular Modelling at the University of Oxford, UK. In 1991, she became a Professor in Theoretical Chemistry at the Faculty of Sciences, University of Porto, where she is today. She is now head the Theoretical and Computational Biochemistry Research Group but has kept her former link to Oxford, becoming an Associate Director, back in 2000, of the Centre for Computational Drug Discovery at Oxford, funded by the National Foundation for Cancer Research. She has been a consultant for a multinational and has performed extensive evaluation work for several research national and foreign entities, including the European Commission. In September 2014, she was awarded a Doctorate *Honoris Causa* by the University of Stockholm, Sweden, for her scientific research, aiming at a better understanding of the functions and applications of enzymes.

She is now the Vice-Rector for Research & Development at the University of Porto. She is a member of the International Committee for the European Doctorate in Theoretical Chemistry and Computational Modelling as well as its homonymous Master Mundus program.

She has published over 300 scientific papers and her scientific research focuses mainly on computational enzymatic catalysis and drug discovery, all aiming at a better understanding of the functions and applications of enzymes.

"Computational strategies in drug discovery "

Biological systems encompass a vast number of problems and we will discuss techniques adopted and/or developed to solve those problems. This talk focuses only on a number of these, which we find useful and interesting to students beginning to develop their liking for computational techniques. We have sought examples that address interesting biological questions. Some research fields will be lightly explored in order to give an overview of interesting work presently carried out within the biological systems theme, namely enzymology and drug discovery. All these illustrate the modern trends in the field, the most common techniques, and what can be gained from computer simulations in terms of predicting the properties of molecules/molecular aggregates and rationalizing experimental observations.

Session moderator

Filipe Mergulhão

Filipe Mergulhão graduated in Chemical Engineering in 1998 at Instituto Superior Técnico (Portugal). In 2002, he obtained his PhD in Biotechnology at the same Institute after a research stay at the Royal Institute of Technology (Sweden). He has completed two Post-Docs, one in 2003 at the Genetics Department of the University of Cambridge (UK) and the second in 2004 at the Chemical Engineering Department of the Massachusetts Institute of Technology (US). He has become an Assistant Professor at the Chemical Engineering Department of the University of Porto in 2005 and was appointed as Invited Assistant Professor at the Microbiology and Immunology Department of the Stanford University (US) in 2012. His research focuses on bacterial biofilms particularly regarding bacterial adhesion, biofilm development and mitigation. He also studies recombinant protein production in bacterial systems.

Hybrid Human

Marco Capogrosso

Marco Capogrosso's interest is the understanding of the neural control of movement with a focus on translational applications in motor disorders. His background in applied physics has strongly influenced his path since the beginning. Indeed, when he started his PhD program in Biomedical Engineering as a fellow of the Scuola Superiore Sant'Anna, in Pisa, he was looking neither for a purely theoretical research program nor purely experimental. His intention was to understand the basic interactions between neuromodulation technologies and sensorimotor circuit dynamics. He wanted to develop theoretical tools to support translation and bring them all the way down to the clinics to test whether his findings and ideas had any impact at all on actual clinical applications. After a PhD and a 3-yr post-doc program under the supervision of Prof. Silvestro Micera first and Prof. Gregoire Courtine later, he is deeply convinced that a theoretical approach to translational neuroscience can have a significant impact on clinical applications. Indeed, he has used computational models to design and implement real-time neurotechnologies that he has tested in rats, non-human primates and humans. He has started with simple models of the peripheral nerve that he has slowly improved to complex neuro-biomechanical models of the spinal sensorimotor circuits, while at the same time performing animal experiments to test his models up to the implementation of real-time technologies able to restore sensation in human amputees and brain-controlled locomotion in non-human primates after spinal cord injury.

"A computational framework for the design of spinal neuroprosthetics"

Severe Spinal Cord Injury (SCI) alters the communication between supra-spinal centres and the sensorimotor networks coordinating limb movements, which are usually located below the injury. Epidural electrical stimulation of lumbar segments has shown the ability to enable descending motor control of the lower limbs in rodents and humans with severe paralysis. Using computational models and in vivo experiments in rodents, we found that EES facilitates motor control through the recruitment of muscle spindle feedback circuits. Stimulation protocols targeting these circuits allowed the selective modulation of synergistic muscle groups, both in rodents and primates. This framework supported the design of brain controlled stimulation strategies that restored locomotion in primates after spinal cord injury, holding promises for applications in humans.

Paulo Flores

Paulo Flores has a Licentiate degree in Mechanical Engineering, at University of Minho (1997), and a PhD in Mechanical Engineering at UMinho, in 2005, which was given the prize "Best PhD thesis in Engineering 2005". Afterwards, Paulo Flores did a post-doc study in the Federal Institute of Technology of Zurich (Switzerland) and at University of Arizona (EUA). In 2011, he obtained the degree of Aggregate in Mechanical Engineering at UMinho. Nowadays, he is a member of the centre for R&D on electromechanic microsystems (CMEMS-UMinho), where he is the coordinator of the investigation group in Systems and Biomedical Applications. His research activity focuses on Mechanical System Dynamics, Mechanisms Science, Tribology, Computational Mechanics, Biomechanics, Medical Devices and Higher Education. In these areas, he has established countless national and international partnerships which resulted in projects and publications in cooperation with Universities and research centres (in European, Australian, North American and Asian areas). He coordinated and participated in more than a dozen I&D projects financed by international and national agencies. He is the author (and co-author) of over 350 papers, books, book chapters, monographies, scientific articles, pedagogical texts, etc. He has edited many books and special numbers of scientific magazines. His works have received 1996/2553 citations (ISI/*Scopus*), and he has an h-index of 27/28 (ISI/*Scopus*). He has received more than two dozen of scientific national and international prizes. He is a member of many scientific and professional associations (national and international). Paulo Flores presides, since 2014, the Technical Commission for Multibody Dynamics from the International Federation Machines and Mechanisms Science (IFToMM). He is a part of editorial bodies of several scientific international magazines. Since 2016, he is editor-chief of *Mechanism and Machine Theory*.

Hugo Paredes

Hugo Paredes received B.Eng. and Ph.D. degrees in Computer Science from the University of Minho, Braga, Portugal, in 2000 and 2008, and the Habilitation title from the University of Trás-os-Montes e Alto Douro (UTAD), Vila Real, Portugal in 2016. He was software engineer at SiBS, S.A. and software consultant at Novabase Outsoursing, S.A. Since 2003, he has been at UTAD, where he is currently Assistant Professor with Habilitation lecturing on systems integration and distributed systems. Currently he is vice-director of the Masters in Computer Science and in Accessibility and Rehabilitation and Engineering.

He is a Senior Researcher at Institute for Systems and Computer Engineering, Technology and Science – INESC TEC. His main research interests are in the domain of Human Computer Interaction, including Collaboration and Accessibility topics. He was guest editor of several Special Issues in journals indexed by the Journal Citation Reports, collaborates with the steering committee of the DSAI International Conference, and authored or co-authored more than 100 refereed journal, book chapters and conference papers. He is one of the inventors of a granted patent and a patent pending request. He participated in several national and international projects, with public and private funding.

"Building an inclusive society through ICT: The case study of assistive technologies for the blind"

In 2014, the World Health Organisation estimated that 285 million people worldwide are visually impaired representing 4% of the population. Sight loss is closely related to old age. Age-related blindness is increasing throughout the world, as is blindness due to uncontrolled diabetes. One in three senior citizens over 65 faces sight loss and 82% of blind people are over 50 years of age. Moreover, according to the Population Reference Bureau nearly 25 percent of people in the European Union in 2030 will be above age 65.

Assistive technologies can provide a remarkable autonomy to the blind and enhance their quality of life, playing an important role in their lives by providing the means to perform their daily living activities. In the last decades, addressing the challenging features and requirements of blind navigation has been a research hot topic. The redundancy of the information and location sources using active and passive sensors, the sensing of the users' surroundings using computer vision, the interaction with the user and his/her safety have been some of the prominent themes. This talk addresses how different technologies can be combined to providing ubiquitous contextual assistance to the blind.

Session moderator

Joaquim Gabriel

Joaquim Gabriel received the degree in Mechanical Engineering from the Faculty of Engineering (UPorto, 1988), specialization on machine design; a post-graduation in Industrial Automation and Process Management; a Master in Industrial Computing, and a PhD in Industrial Electronics from the University of Minho (2003). He was research fellow of JNICT (National Research Association), with the project "Development of Virtual Instrumentation" (1989) and from the Japanese Ministry of Industry EU-STA at Kanagawa Science Park, Japan (1995-97), with the project "Very High Precise Positioning Using Piezoelectric Actuators". In 2012, he was invited researcher at Yokohama City University, Japan. Since 2003 is assistant professor of FEUP, integrated in the group of Automation, Instrumentation and Control, teaching in the MSc courses of Management and Industrial Engineering, Mechanical Engineering, Electrical Engineering and Computers, Chemistry, Bioengineering. Joaquim Gabriel is researcher of the FCT Unit - UISPA - Integration Unit Systems and Process Automation, external researcher of Cardiovascular Unit - FMUP, and LABIOMEP UPorto Biomechanics Lab, integrated in INEGI - Institute of Science and Innovation in Engineering Integrated Mechanical and Industrial Engineering and in LAETA - Associated Laboratory of Energy, Transports and Aeronautics. His main interests are instrumentation, supervisory control and data acquisition - SCADA, industrial automation, medical devices, thermography.

Engineering: the Keymaster of the Human Body

Emanuel Sousa

Emanuel Sousa holds a Ph.D. in Electronics and Computers Engineering, from the University of Minho. During his PhD, he worked at the research lab on Autonomous (mobile and anthropomorphic) Robotics & Dynamical Systems – MAR Lab – , at the University of Minho/Centre Algoritmi /Dept of Industrial Electronics, under the supervision of Professor Estela Bicho, on the development of neuro-inspired computational models for allowing robots to learn from observation of human demonstrators and tutors feedback. Since 2009, he has collaborated in R&D projects funded by the Portuguese government and European Commission, focused on human-robot interaction and collaboration, and Learning-by-demonstration. Currently, he is a researcher and project manager of the PIU group (Perception, Interaction and Usability) at the Centre for Computer Graphics in Guimarães, where he has been working on analysis of human bio-motion and behaviour on HMI contexts.

"Towards Robots as Socially Intelligent Assistants: from the neurocognitive basis of joint action in humans to human-robot collaboration"

As robot systems are moving as assistants into human everyday life, the question how to design robots capable of acting as sociable partners in collaborative joint activity becomes increasingly important. The capacity to anticipate and take into account action goals of a partner is considered a fundamental cognitive capacity for successful cooperative behaviour in a shared task. I will report about our approach at UMinho towards creating socially intelligent robots that is heavily inspired by recent experimental and theoretical findings about the neurocognitive mechanisms underlying joint action in humans. We believe that designing cognitive control architectures on this basis will lead to more natural and efficient human-robot interaction/collaboration since the teammates will become more predictable for each other. Central to our approach, we use neuro-dynamics as a theoretical language to model cognition, decision making and action. The robot control architecture is formalized by a coupled system of dynamic neural fields representing a distributed network of local but connected neural populations with specific functionalities. Different pools of neurons encode task relevant information about action means, action goals and context in form of self-sustained activation patterns. These patterns are triggered by input from connected populations and evolve continuously in time under the influence of recurrent interactions. The dynamic control architecture has been validated in tasks in which an anthropomorphic robot – ARoS - acts as an assistant or co-worker in joint construction tasks. I will show that the context dependent mapping from action observation onto appropriate complementary actions allows the robot to cope with dynamically changing joint action situations. More specifically, the results illustrate crucial cognitive capacities for efficient and successful human-robot collaboration such as goal inference, error detection at multiple levels (e.g. intention, means and execution), anticipatory action selection, and learning.

Patrícia Figueiredo

Patrícia Figueiredo graduated in Physics and Engineering from Instituto Superior Técnico (IST) at the Technical University of Lisbon, completed the post-graduation in Biophysics and Biomedical Engineering at the Faculty of Sciences of the University of Lisbon, and subsequently obtained the D.Phil. degree in Clinical Neurology from the University of Oxford, where she worked with Prof. Peter Lezzard at the Centre for Functional Magnetic Resonance Imaging of the Brain (FMRIB). She was then invited lecturer at Thammasat University, in Thailand, before returning to Portugal as a post-doctoral researcher at the Institute for Biomedical Imaging and Life Sciences (IBILI), of the Faculty of Medicine of the University of Coimbra. She is currently a tenured Assistant Professor at the Department of Bioengineering at IST, of the University of Lisbon, and the coordinator of the Evolutionary Systems and Biomedical Engineering Lab (LaSEEB) of the Institute for Systems and Robotics, Lisboa (ISR-Lisboa). During the past ten years, she has been responsible and participated in several national and international research projects in brain imaging, neuroscience and biomedical engineering, and she has been the author of over 30 papers in international journals of high impact in these fields. Her work has been distinguished with the Prize for Women in Science by L'Oréal Portugal, the 2nd best paper award by the Portuguese League against Epilepsy, and the António Xavier Prize for the best Portuguese PhD Thesis (as advisor) in NMR, EPR or MRI. Her current research interests are focused on imaging human brain function and physiology in both health and disease, using multiple functional MRI techniques as well as their multimodal integration with EEG.

"Multimodal brain imaging: challenges and applications"

Brain imaging plays a crucial role in both basic and clinical neuroscience. In particular, functional imaging techniques are expected to deliver sensitive biomarkers for diagnosing and monitoring several neurological and psychiatric diseases. Functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) are arguably the most important functional brain imaging techniques today. Because they provide highly complementary information in terms of the nature and the spatiotemporal resolution of the data, their multimodal combination has been actively sought for the past two decades. However, a number of both methodological and conceptual challenges remain that limit its wider applicability. One of the challenges is the extraction of good quality EEG data by appropriately accounting for the severe artefacts that affect its acquisition in the MR environment, which can largely overwhelm the signals of interest. Another challenge resides in the identification of the optimal approach for the integration of EEG and fMRI data. In this talk, I will start by introducing the technique, and I will then present new methodological approaches for the minimisation of EEG artefacts and for the integration of EEG and fMRI signals. I will illustrate the applications of the technique, by showing results of EEG-fMRI studies of epileptic patients.

Brígida Mónica Faria

Brígida Mónica Faria has a BSc degree in Mathematics from the Faculty of Science, University of Porto, MSc in Multimedia Technology from the Faculty of Engineering, University of Porto (2008) and PhD in Computer Science from the University of Aveiro. She is an Adjunct Professor at School of Health, Polytechnic of Porto (ESS – P. Porto) and researcher at LIACC - Artificial Intelligence and Computer Science Laboratory. She has extensive teaching experience in the fields of Informatics, Data Analysis, Medical Informatics, Health Sciences and Technologies, Statistics and Mathematics. She conducts research in the areas of Machine Learning, Data Mining, Medical Informatics, Information Systems, Intelligent Robotics, Human Machine Interfaces and Serious Games. She participated in 10 research projects and developed several fully-functional prototypes in these areas. She supervised 14 dissertations and she is the author of more than 50 journal/conference publications indexed at SCOPUS and/or ISI Web of Knowledge.

"(Big) Data Analysis and its Opportunities: Healthcare Applications"

Nowadays, (Big) Data is generated by everything at all times from multiple sources at great velocity, volume and variety. Data analysis is widely used in many different areas such as Business and Financial Services, Science and Technology, Energy sector or Medicine and Healthcare. This talk presents some opportunities by using data analysis to enhance knowledge and several applications in the area of healthcare. For example, the quality of life (QOL) is considered an important aspect in clinical practice for patients with chronic illnesses. It will be presented how an information system (IS) which will use the physical and behavioural data of the patient in conjunction with machine learning techniques, allows assessment of QOL reducing the response time to the questionnaires and without affecting the daily patient. Data analysis was also used and analysed using knowledge discovery methods, in order to create an automatic patient classification system. Based on the classification system, a methodology was developed enabling to select the best interface and adapt a command language for each patient.

Session moderator

Pedro Amorim

Pedro Amorim is an anaesthesiologist in Hospital de Santo António since 1983 and he is the Chief of Staff of the Anaesthesiology Department. He graduated in 1979, at the Faculty of Medicine of the University of Porto. Few years later, in 1991, he went to the State University of New York to do research and post graduated training. As a Doctor of Medicine, Pedro Amorim is deeply concerned with the patient's well-being, the safety in anaesthesiology and surgery and the quality of recovery following that same procedures. On the other hand, as an educator, he cares about training at pre-and post-graduate levels and narration and medicine. Regarding social causes, Pedro supports humanitarian medicine. Currently he is also very interested in neurosciences, brain monitoring, pain protection and effects of anaesthetics on the brain.

Industrial Biotechnology: engineering with life

Garabed Antranikian

Dr. Garabed Antranikian studied Biology at the American University in Beirut. At the University of Göttingen, Germany, he completed his PhD in Microbiology in 1980 in the laboratory of Professor Gerhard Gottschalk and qualified as a post-doctoral lecturer (Habilitation) in 1988. In 1989, he was appointed to a professorship in Microbiology at the Hamburg University of Technology, Germany, where he has been the head of the Institute of Technical Microbiology since 1990. From 1993 to 1999 he coordinated the EU network project Extremophiles with 39 Partners from academia and industry. From 2000 to 2003 Prof. Antranikian coordinated the national network project Biocatalysis and is coordinating the Innovation Centre Biokatalyse (ICBio, supported by DBU) since 2002. He was president of the International Society for Extremophiles and is chief editor of the scientific journal Extremophiles. In 2004, he was awarded the most prestigious prize for environment protection by the president of the Federal Republic of Germany. Since 2007 he is the coordinator of the "Biocatalysis2021" Cluster and the "Biorefinery2021" Cluster of the Ministry of Education and Research and he is chairman of IBN Industrial Biotechnology North. He is member of the Academy of Sciences of Hamburg and member of the Union of the German Academies of Sciences (acatech). He was vice president for academic affairs from 2009 to 2011 before he became president of Hamburg University of Technology in April 2011.

"Extremophiles for a Sustainable Biobased Industry"

Industrial biotechnology is an emerging field of enormous socio-economic importance. It has the potential to create cleaner and more efficient bio-processes to replace existing chemical processes. The current value of chemical products produced using biotechnology is estimated to be more than 150 billion dollars and is expected to reach 450 billion dollars in 2020. It is also an important technology for the energy sector as energy derived from biomass starts to cover an increasing amount of our energy needs. The implementation of biorefineries of the second and third generation will be crucial for the development of future sustainable technologies. The keys to unlock this tremendous economic potential in industrial biotechnology are enzyme-based processes. Due to the relative ineffectiveness of standard laboratory culture techniques, the potential wealth of biological resources in nature is still relatively unknown, and uncharacterised. A key source of natural enzymes suitable for industrial production are extremophiles. The goal of research of our institute in this field is to provide unique microorganisms and enzymes (extremozymes) so that they can be adapted for use in various industries.

In order to strengthen this growing field of biotechnology, it is necessary to make the natural enzyme diversity accessible to industrial processes at reasonable cost. As the demand for robust enzymes, which can be used under unconventional process conditions becomes more and more obvious, we search the Earth's ecological niches for novel biocatalysts and produce these in substantial quantities. Activity and sequence-based approaches are used for the discovery of novel hydrolases with unique properties e.g. solvent tolerance, unique specificity, broad temperature and pH range. Modern techniques such as synthetic biology, HTS are applied in order to produce tailor-made enzymes, which meet the specific needs of the industrial process. The application of unique polymer degrading enzymes for the bioconversion of terrestrial and marine biomass such as plants and algae to valuable products such as sugars, chemicals, and energy carriers will pave the path for the development of sustainable biorefinery. The enzymes of interest are robust cellulases, hemicellulases, laminarinases, alginate lyases, and

various glucosidases. Our approach represents an innovative and promising way to design versatile biocatalysts with great potentials for both academia and industry.

Filomena Freitas

Filomena Freitas is a Senior Researcher at the Biochemical Engineering Group (BIOENG), at UCIBIO-REQUIMTE, FCT-UNL. She has completed a PhD in Biological Engineering by Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (FCT-UNL) in 2004. She has developed research on the development of upstream and downstream processes for the production of value-added microbial products, including polysaccharides and polyhydroxyalkanoates, as well as intellectual property development and technology transfer. Special focus is also given to the biological valorisation of agro-industrial wastes/by-products, aiming at implementing sustainable bioprocesses. She has 47 published papers in international peer review journals, 7 book chapters and 5 International Patents, which have recently been granted in several countries. She has participated in several projects in collaboration with Industry Partners. Her theme was awarded for the most innovative project at the Solvay&Hovione Ideas Challenge Prize (2008).

"Production of microbial biopolymers"

Biopolymers are naturally synthesized by many microorganisms with different functions in the cell, including intracellular carbon or energy storage reserves, such as PHAs, and extracellular polysaccharides (EPS), often secreted as protective mechanisms in response to environmental conditions. Such biopolymers are characterized by different molecular structures that result in a wide range of functional properties that range from rheology modifiers of aqueous systems to bioplastics. In spite of their potential for applicability in different areas, only a few have found widespread. The industrial production of most microbial biopolymers is performed using single strain systems. Nevertheless, mixed microbial consortia, which have no sterility requirements, are nowadays emerging as potential PHAs producing systems. In many industrial bioprocesses for the production of microbial biopolymers, sugars, like glucose or sucrose, are usually used as carbon sources because they allow for high productivities and yields. The use of low-cost agro-food or industrial wastes and by-products (e.g. cheese whey, molasses, glycerol by-product, used cooking oil, etc.) as substrates for bacterial cultivation is being investigated as a strategy to lower production costs of several microbial products. Although promising, the use of such low-cost substrates may present some associated problems. Different metabolic pathways may be followed due to the different nutrient composition and the presence of contaminants, eventually resulting in the synthesis of different polymers and/or unwanted by-products. For specific high-value applications, wherein high-purity and high quality products are needed, good quality substrates are usually preferred to reduce the risk of impurities carryover to the final product. In such cases, the use of wastes or by-products may not be an option or otherwise, higher investment must be put in downstream procedures.

José A. Teixeira

José António Teixeira is currently Professor ("Professor Catedrático") at Biological Engineering Department, University of Minho (since 2000). He has a degree in Chemical Engineering from University of Porto (1980) and a PhD in Chemical Engineering also from University of Porto (1988). He has been involved in different management activities, being Head of the Department of Biological Engineering, Univ. Minho, 2000 -2012 and Head of Biological Engineering Research Centre, 2012-2015. His main research interests are Industrial Biotechnology (bioprocess development for the transformation of lignocellulosic materials into 2nd generation bioethanol and chemicals; valorisation of agro-industrial residues; bioreactor development including new design bioreactors and continuous processing) and Food Biotechnology (non-conventional food processing; edible films for packaging; process development for production of prebiotics) He was responsible/co-responsible for the Supervision of 31 PhD theses and 20 Post-docs and has been the coordinator of 32 scientific research projects, 7 of which international José Teixeira was awarded the "Stimulus to Excellence", 2006, from FCT, the "Seeds of Science" in "Engineering and Technology", 2011, from "Ciência Hoje" and the "Scientific Merit Award", Universidade do Minho, 2015. He is the co-editor of the books "Reactores Biológicos-Fundamentos e Aplicações" (in Portuguese), Engineering Aspects of Milk and Dairy Products and Engineering Aspects of Food Biotechnology and the author/co-author of over 480 peer reviewed papers (see http://orcid.org/0000-0002-4918-3704).

"Developments in the production of 2nd generation bioethanol"

Currently, biofuels from renewable sources are recognized as one of the possible alternative to reduce the greenhouse emissions caused by the increasing oil-based fossil fuel consumption. It is expected an increase of these advanced (no-starch) biofuel by 2022. Nevertheless, the moderate development of cellulosic biofuel industry hinders to progress in this field being necessary advances on techno-economic process, mainly. In this sense, the sustainable use of lignocellulosic biomass in a biorefinery scheme (in which other products are obtained) is shown as sustainable way for the biofuels production. Therefore, the main challenge of lignocellulosic bioethanol production or second generation bioethanol remains on feasibility of process which should be approached from global perspective taking into account all of stages involved in the process: pretreatment, enzymatic saccharification and fermentation. An effective pretreatment plays a key role in the success of process since it is considered the first step of a biorefinery and therefore, influences in subsequent stages of biofuel production. Hydrothermal treatments or organosolv processes satisfy main requirements for a suitable pretreatment (such as high cellulose recovery, lignin or hemicellulose solubilization with limited degradation). In addition, the pretreatment should increase the enzymatic susceptibility of cellulose allowing the high pretreated biomass loadings in the process of saccharification to achieve competitive ethanol concentration. Moreover, the intensified conditions of these processes required robust strains able to ferment in these extreme conditions of process: high temperature, high solid loadings and presence of inhibitory compounds (derived of pretreatment). For the consolidation of 2nd generation bioethanol process, the intensification of all involved stages of process from an integrated point of view is mandatory. The presentation will address the main results obtained considering the integrated development of processes for the production of 2nd generation bioethanol with a particular emphasis on the work being developed at Centre of Biological Engineering.

Session moderator

Nuno Azevedo

Nuno Azevedo obtained his degree in Biological Engineering in 2001 at the University of Minho (UMinho), Portugal. He then finished his PhD on Chemical and Microbial Technology in 2005 at the same institution. After holding a Post-doctoral position at the UMinho and the University of Southampton (UK) for 4 years, he started a Faculty Research Fellow position at the Faculty of Engineering of the University of Porto in June 2009.

Nuno Azevedo's main research interests are to understand the population dynamics in biofilms and explore the potential of peptide nucleic acids (PNA) and other nucleic acid mimics for rapid localization and detection of microorganisms. In order to better explore the commercial applications of PNA, he was the co-founder of BioMode - Biomolecular Determination SA, a company that has raised 1.6 million € in venture capital investment in 2014. During his career as a researcher/entrepreneur he has received several awards including the BES 2012 Innovation prize in the panel of Food and Natural Resources.

Blue Biotechnology: sea solutions

Luísa Gouveia

Luísa Gouveia is a Senior Researcher at the National Laboratory of Energy and Geology (LNEG), being the head of the Autotrophic Microalgae Unit at this same laboratory. She is a Chemical Engineer, holding a MSc in Food Science and Technology, as well as a PhD in Biotechnology. Dr. Luísa is Vice-Chair and National Delegate of the COAT Action 1408 – EUALGAE –European network for algal-bioproducts and, apart from that, she has coordinated several projects related to Microalgae: Pigments, Fatty Acids, Biofuels (Biodiesel, Bioethanol, Bio-Hydrogen, Biogas), Wastewater Treatment, CO2 Mitigation, Supercritical Fluid Extraction, Biorefinery, Life Cycle Analysis. In addition to having published 70 articles in peer-reviewed journals, 1 book, 10 book chapters, 135 publications in conference proceedings and 1 patent, she is also an Associate Editor of "Biotechnology for Biofuels" and a regular referee for more than 50 scientific journals.

"Blue Biotechnology: all colours of microalgae"

Autotrophic microalgae carry out the photosynthetic conversion from light into organic compounds. Microalgal cultivation brings environmental advantages, highlighting the capability of nutrient recycling from wastewater combined with CO2 fixation from flue gases towards a wide range of 3G biofuels and bioproducts. These micro-organisms have been widely recognized as having huge potential as feedstock for food and feed industries, as "nutraceutical" agents (carotenoids, antioxidants, polyunsaturated fatty acids, single-cell proteins (SCP), phycobiliproteins, polysaccharides, vitamins, phytosterols, minerals), for the cosmetic industry, bioplastics, agriculture biofertilizers and recently as an energetic vector towards the production of a wide range of biofuels. Microalgae exhibit clear advantages when compared with higher plants, such having a higher photosynthetic efficiency, higher areal biomass productivities, higher CO2 biofixation rates from flue gases emitting plants, higher O2 production rates, non-competition for agricultural areas (marginal lands such as deserts, rocky areas and salt pans can be used), non-competition for drinking waters (saltwater, brackish water and wastewaters can be used), harvesting routines can be carried out daily with better equipment and better resource management lowering storage costs. The presentation highlighted the potential of the microalgae to all the industry sectors emphasizing the production of biofuels and bioproducts within the biorefinery concept.

Vítor Vasconcelos

Full Professor - Faculty of Sciences of Porto University and researcher - Interdisciplinary Centre of Marine and Environmental Research – CIIMAR. PhD in Biology at FCUP, Porto.

Director of the Group of Blue Biotechnology and Ecotoxicology (LEGE lab), studying natural toxins and other bioactive substances and their effects in the environmental and human health. Main research focus on cyanobacteria toxins: diversity, dynamics of intoxication and environmental and human health risks assessment. More recently works on marine emergent toxins and associated organisms: tetrodotoxins, ciguatoxins, palitoxins and analogues. Other research lines include Biotechnological application of secondary metabolites isolated from microorganisms. Responsible for the LEGE culture collection comprising more than 400 strains of cyanobacteria from marine and freshwater origin. Supervised 65 MSC and 25 PhD students.

Published 270 papers in Toxicology and Biotechnology (orcid.org/0000-0003-3585-2417). Participated in more than 40 projects being at the moment coordinator of two projects (one national and one European) and participates in two H2020 project on Blue Biotechnology.

"Cyanobacteria secondary metabolites with biotechnological applications"

Cyanobacteria are very diverse organisms in terms of morphology, habitat and ecology and are well known for the diversity of secondary metabolites. Among those metabolites, toxins are extensively studied due to the harmful effects on the ecosystems and on human health. Cyanotoxins can have neurotoxic, hepatotoxic, cytotoxic and dermatoxic properties, being exposure to humans via drinking water, dermal contact during recreation or via food contaminated with the toxins. Cyanotoxins can also be used as tools for the study of cell biology with potential application in the treatment of some human diseases. Cyanobacteria are also a prolific source of compounds with potential biotechnological applications, namely in the pharmacological field. A wide range of secondary metabolites exhibiting pharmacodynamic properties such as antibacterial, antiviral, antifungal, anti-inflammatory and anticancer have been described. We have found among them, cyanobactins, non-ribosomally produced cyclic peptides. Cyanobacteria extracts have also been pointed out as neuro-apoptogenic and thrombocyte function modulating. Bioactive compounds from cyanobacteria may also have allelopathic activity with potential use to control algal blooms or as antifouling in the marine environment. Cyanobacteria extracts can also prevent the development of some invertebrates such as sea urchins and mussels and so they can be candidates to develop environmentally friendly antifouling agents.

Jorge Temido

Buggypower Chief Process and Innovation Officer (CPIO). PhD in Civil Engineering - Hydraulics, Water Resources and Environment and a degree of Graduate Civil Engineer, both from University of Coimbra. Jorge Temido's main expertise is in design engineering (PE) of water and wastewater systems. Jorge Temido's interest in innovation and business strategy led him to hold positions as Entrepreneur, R&D manager, Board Adviser, and Consultant at companies in Water, Food, and IT sectors. Through all his professional career, Jorge Temido kept his activity as University Professor of Water and Wastewater Engineering (+25 yrs.) and as Professor of Management and Entrepreneurship.

"BUGGYPOWER microalgae biorefinery State-of-the Art: The Production Unit of Porto Santo, Madeira"

Session moderator

Manuel Simões

Manuel Simões studied Biological Engineering and received a PhD in Chemical and Biological Engineering from the University of Minho. He is currently Assistant Professor and member of the LEPABE in the Department of Chemical Engineering of the Faculty of Engineering of the University of Porto. His main research interests are currently focused on biofilm science and engineering, particularly on the mechanisms of biofilm formation and their control with antimicrobial agents.

"Biotech Lab 2.0"

João Ribas

João Ribas holds an M.Sc. in Molecular Biology from the University of Coimbra in collaboration with the Institute of Molecular and Cell Biology (IBMC), University of Porto. He is currently a Ph.D. candidate working on organs-on-a-chip, microfluidics, tissue engineering and medical devices at Harvard Medical School, Brigham and Women's Hospital and Harvard-MIT Health Sciences and Technology Division. He has published over 15 scientific articles in journals such as Small, PNAS, Lab-on-a-chip, and Nature Reviews. João is a former partner at Multiply Labs and is currently a healthcare innovator at MIT Hacking Medicine.

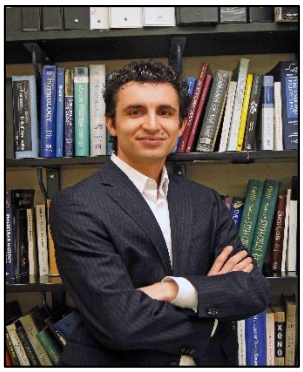
"Vascular aging-on-a-chip: a young solution for an age-old problem"

Organ-on-a-chip platforms aim at simulating the complex microenvironment of human organs using microbioreactors. Beyond mimicking healthy organ functions, a growing number of organ-on-a-chip devices have been used to model human diseases, serving as a platform for drug discovery and testing. Hutchinson-Gilford progeria syndrome (HGPS) is a premature aging disease where patients show accelerated vascular aging. HGPS targets primarily mechanically loaded tissues such as vascular cells. Here, we generated a progeria-on-a-chip model to unveil the effects of biomechanical strain in the context of vascular aging and disease. Our findings showed that physiological strain induced a contractile phenotype in primary smooth muscle cells (SMCs), while a pathological strain induced a hypertensive phenotype similar to that of angiotensin II treatment. Interestingly, SMCs derived from human induced pluripotent stem cells of HGPS donors, but not healthy donors, showed an exacerbated inflammatory response to strain. In particular, we observed increased levels of inflammation markers and DNA damage. Pharmacological intervention was able to reverse the exacerbated response to strain. The progeria-on-a-chip is a relevant platform to study biomechanics in the setting of vascular disease and aging, while simultaneously facilitating the discovery of new drugs and therapeutic targets.

Lino Ferreira

Lino Silva Ferreira holds a Ph.D. in Biotechnology from the University of Coimbra (Portugal). He did postdoctoral work at INEB and MIT (USA) in the areas of stem cells, micro- and nanotechnologies. He joined the Center of Neurosciences and Cell Biology (CNC, University of Coimbra) in 2008. He has published more than 100 peer-reviewed papers and has 20 issued or pending patents– 8 of which have been licensed to companies in the biomedical industry. He is the director of the Biomaterials and Stem Cell-Based Therapeutics research group, CNC coordinator of the MIT-Portugal Program and the founder of the biotech company Matera. In 2012, he was awarded with a prestigious European Research Council starting grant and in 2016 with an ERA Chair position in Aging. His research group has two main avenues of research: (i) development of tissue models to screen drugs and study diseases, (ii) development of nanomedicine platforms to modulate the activity of stem cells and their progenies. The seminar will focus in the use of stem cells to develop tissue models for drug screening and study diseases.

"Human tissues grown in a dish"



Pedro Baptista

Prof. Pedro Baptista is currently a Group Leader at the Aragon Health Research Institute (IIS Aragon) in Zaragoza, Spain and the founder of the Organ Bioengineering and Regenerative Medicine Laboratory at the Aragon Biomedical Research Institute (CIBA) in Zaragoza, Spain. He is also an Assistant Professor at the Biomedical and Aerospace Engineering Department of University Carlos III of Madrid, Spain. He has authored two books, several book chapters and multiple papers and reviews published in prestigious scientific journals. His current research main focus is on developing bioengineered solid organs for transplantation by advancing organ decellularization and recellularization technologies. Hence, his lab also works on the development of novel methods to expand iPS and adult human stem/progenitor cells to the required large numbers necessary for organ bioengineering; the advancement of the current bioreactor technologies; and the design of novel preservation/maintenance solutions to keep these organs viable ex vivo for long-term. The integration of these research lines will undoubtedly contribute to make the lasting transplantation of these labgrown organs a reality. Prof. Pedro Baptista is also interested in applying bioengineered hepatic tissues and organs to study developmental biology, physiology and drug discovery.

"Self-assembled liver organoids recapitulate hepato-biliary organogenesis in vitro"

Several 3D cell culture systems are currently available to create liver organoids. In general, these systems display better physiologic and metabolic aspects of intact liver tissue, compared with 2D culture systems. However, none of these reliably mimic human liver development, including parallel formation of hepatocyte and cholangiocyte anatomical structures. Here, we show that human fetal liver progenitor cells self-assemble inside acellular liver extracellular matrix (ECM) scaffolds to form 3D liver organoids that recapitulated several aspects of hepato-biliary organogenesis and resulted in concomitant formation of progressively differentiated hepatocytes and bile duct structures. The duct morphogenesis process was interrupted by inhibiting Notch signalling, attempting to create a liver developmental disease model with a similar phenotype of Alagille syndrome. In the current study, we created an in vitro model of human liver development and disease, physiology and metabolism, supported by a liver ECM substrata. We envision that it will be used in the future to study mechanisms of hepatic and biliary development, and for disease modelling and drug screening.

Session moderator

Inês Gonçalves

Inês C. Gonçalves graduated in Microbiology from Escola Superior de Biotecnologia, Universidade Católica Portuguesa in 2003. She got her PhD in Biomedical Engineering from the Faculty of Engineering, University of Porto in 2009. Her thesis was based on biomaterials for blood contact, focusing on the development of molecularly engineered self-assembled monolayers and polymers to bind albumin and reduce thrombus formation in cardiovascular devices. The work was developed at INEB (Biomedical Engineering Institute), in Porto, and at UWEB (University of Washington Engineered Biomaterials), in Seattle.

Between 2010 and 2013 was Post-Doc at INEB and IPATIMUP, focusing her work on biomaterials to prevent gastric cancer, developing glycosylated mucoadhesive microspheres to eliminate gastric infection caused by *Helicobacter pylori*. In 2013 was hired as researcher by INEB, continuing this line of work, and developing a new area of research using graphene-based biomaterials for different biomedical applications.

She has been involved in 9 research projects, 3 of them as principal investigator, co-organized 9 national/international conferences and is coordinator of the initiative "Porto de Crianças" at INEB that aims to provide primary school children a first contact with science.

Inês Gonçalves is also Invited Assistant Professor at FEUP – Faculty of Engineering of Porto University (since 2010) and at ICBAS – Instituto de Ciências Biomédicas Abel Salazar (since 2013), lecturing in BioEngineering Integrated Master (MIB) and Biomedical Engineering Master.

She is the author of 18 papers in top specialty international journals and has one filled international patent. She has given over 35 oral communications and presented over 25 posters in international conferences. She has supervised/co-supervised 6 MSc thesis, and is currently supervising 2 MSc thesis and co-supervising two PhD theses. Her work has been recognized with 6 national and international awards, including "Pulido Valente Science Prize 2006" and "Medal of Honor L'Oreal for women in science 2013.

Speed-ticketing science evolution

Thomas Landrain

Thomas Landrain is cofounder and president of La Paillasse, the first French and one of the world largest community labs that foster open science and technology. He claims that there is no monopole for great ideas and has been working on re-founding the concept of laboratory for the upcoming era of collective intelligence, fast prototyping and big data within an open framework. He first did a career in academia after graduating from Ecole Normale Superieure and co-founding the first French synthetic biology lab at Genopole where he did his PhD. He is also the co-founder and CEO of PILI, a start-up that uses synthetic biology to produce natural dyes without petrochemicals and pesticides. Thomas is currently working on the foundation of an open and distributed research institute, using the CommonGround framework, whose goal will be to synchronize and empower millions of independent researchers. Last but not least, Thomas is a strong advocate of open science and biohacking/DIYbio, travelling the world as a speaker to share his visions and observations of open and collaborative research practices and the upcoming open biotech revolution.

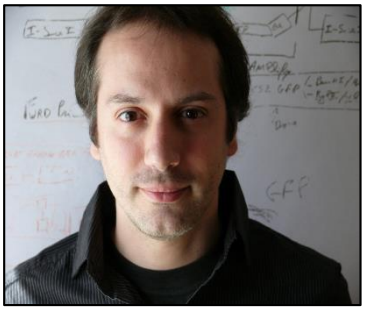
"Exploring the dark matter of Science"

Production of scientific knowledge relies on collaborative actions, whether for data collection, analysis, constructive criticism or peer reviewing. The digital era, with communities of almost limitless size and diversity, now enables the exploration of new collaborative behaviours. Moreover, the speed of data transfer and instantaneous resource access renders geographical localization meaningless. With these new practices in place, Science can hardly remain the exclusive property of physical institutions. On the contrary, it could benefit from a more decentralized and inclusive framework.

There are today examples in the international community of initiative that can bring hundreds of contributors together for producing scientific knowledge or creating tech devices. The do-it-yourself biology (DIYBIO) community and the IGEM competition are such examples applied to the use of biology in open and interdisciplinary environments.

The DIYBIO community revolves around the principle that biology is too important to be let in the hands of professional and so foster the creation of technologies and services that help biology to be used outside the wall of institutions in a collaborative manner.

IGEM is an international initiative to bring students to work together as teams on synthetic biology projects. What makes IGEM so remarkable as a competition is how every project must be entirely documented on wikis, making it easy to track and quantity contributions to the team projects from each member. In order to better understand and characterised what makes a team better performing than others, we will be studying the international Genetically Engineered Machine (iGEM) competition, for which more than 2000 teams, 10 000 participants over 12 years, have been producing interdisciplinary projects, as concrete and recent examples of new ways to grasp, share and utilize resources to perform knowledge production. Building on those, we will seek to offer an insight on what the future paradigm of scientific work could be in the context of open and massive collaborations. Finally, using as a case study Epidemium, an open and collaborative scientific program that investigates cancer epidemiology, we shall discuss how this uncovers new perspectives and interrogations on the structural nature of future scientific communities.



José Bessa

José Bessa completed his PhD degree in Developmental Biology at ICBAS (University of Porto; 2008), acquiring advanced knowledge in the development of Drosophila and Zebrafish visual systems, under the supervision of Dr. Fernando Casares. As a postdoc, he has joined the laboratory of Prof. J.L. Gomez-Skarmeta, an expert in Functional Genomics. Currently, José Bessa is the group leader of the Vertebrate Development and Regeneration group, at I3S - "Instituto de Investigação e Inovação em Saúde" and IBMC - "Instituto de Biologia Molecular e Celular", Porto. His current research interests are within the field of transcriptional cis-regulation, and his research addresses the impact that non-coding mutations have on pancreas development, function and disease. To reach this goal, the Bessa´s laboratory uses the Zebrafish as a vertebrate model system and employs genome wide techniques to detect pancreas cis-regulatory elements and state-of-the-art genome engineering approaches to induce cis-regulatory mutations. Among several recent achievements, Jose Bessa was awarded a European Research Council starting grant.

"The use of CRISPR to crack the transcriptional regulatory code of the zebrafish"

The transcriptional regulation of genes is fundamental for the proper development, function and homeostasis of organs and is achieved by non-coding cis-regulatory elements (CREs) spread over large genomic distances. However, little is known about the code behind transcriptional regulation of genes and how mutations on CREs may eventually impact in the activity of their target genes. To address these two main problems, we are developing different strategies using the CRISPR system and employing them in our favourite vertebrate model system, the zebrafish.

Session moderator

Júlio Santos

Júlio Santos is a biologist and science communicator. Over the years, he has taken part in many scientific culture initiatives and dissemination projects targeted to assorted audiences. Between 2003 and 2014 he was head of IBMC.INEB Office for Science Communication to then, in 2015, take part on the coordination of i3S Communication Unit. His extensive activity encompasses participation in projects of scientific culture dissemination, as well as research-action science communication projects funded both nationally and internationally, namely the "Evaluating the state of public knowledge on health and health information in Portugal" and of a Portuguese Science Shop project "Engaging Society: Life Sciences, Social Sciences and Publics" (both national funded); and also the EU projects NERRI, PARRISE, and was third party in the national hub of RRI TOOLS project. He organizes, promotes and teaches several advanced trainings for scientists on "Science, Ethics and Society" and other audiences, including continuous training activities for high school teachers. He also has a seat in the Board of Directors of the Scicom.pt network and is a member of many other advisory boards.

Carlos Conde

Carlos Conde graduated in Applied Biology at the University of Minho in 2002 and obtained a PhD degree in Biological Sciences in 2007 by the University of Minho and University of Poitiers (France) for his studies on the molecular mechanisms underlying sugar sensing and control of transmembrane transport of photoassimilates in higher plants. In 2009, he joined the lab of Claudio Sunkel as an FCT Post-Doc fellow to study the molecular underpinnings that regulate chromosome segregation. He currently holds an FCT Investigator position to lead an independent line of research that addresses how cells prevent genomic instability during cell division and lectures molecular biology at ICBAS/UP as an assistant professor.

A Tour through Bioentrepreneurship

Filipe Cardoso (Magnomics)

Filipe Cardoso graduated in Physics Engineering at Instituto Superior Técnico – Lisbon University in 2005. During his PhD in the same university and at INESC-MN, Filipe has developed an innovative technology for rapid detection of several biological parameters inside a miniaturized biochip. After PhD, Filipe maintained his research activities as a post-doc at INESC-MN in the field of innovative technologies for bio-detection as well as on an innovative technology for non-destructive testing for aeronautics and nuclear plants. Filipe has co-advised several master students and a PhD student and has coordinated INESC-MN team in 4 European projects and 5 Nacional projects (FTC). He is the author of over 40 peer-reviewed papers published in high impact factor journals. He is also the inventor of 4 patents. With his experience in new technologies for biodetection, Filipe cofounded Magnomics with 4 partners. Filipe currently serves Magnomics as CTO.

MAGNOMICS
NANOTECH FOR LIFE SCIENCES

"The creation of a medtech company: Magnomics case"

Magnomics is a company developing a new technology for detecting different bacteria and their resistance at the point-of-care. This presentation will focus on the creation of Magnomics. What is Magnomics technology? What advantage this technology has compared to others? How was the team formed? How was the application chosen? How was the necessary investment obtained? These are some of the questions that will be answered during the presentation. Further to this, the presentation will also include current developments and future perspectives for Magnomics.

João Pedro Ribeiro (PeekMed)

João Pedro Ribeiro is the CEO of PeekMed, a pre-operative planning system for Orthopaedic surgery. He is a Biomedical Engineer with a Mater's degree in Medical Informatics. Considers himself as a geeky perfectionist and passionate about technology and medical imaging. Quit his job to start PeekMed in order to help simplify the way orthopaedic surgeons interact with technology and plan the surgeries.

"How can technology make a dent in Orthopaedics?"

Medicine has been one of the fields which uses the state of the art technology since always. This also applies to Orthopaedics. However, at some point, this medical branch stopped innovating, and surgeons felt it. What has been made to help these surgeons? What kind of technologies? What can we do to change this and help this physicians with their difficult task?

José Eduardo Amorim de Sousa (5ensesinfood)

José Eduardo Amorim de Sousa got his Licentiate degree in Mechanical Engineering (1979) from Faculdade de Engenharia da Universidade do Porto, after which he earned his MSc in Fluid Dynamics from von Karman Instituut voor Stromingsdynamica (1980). He attended a Program in Business Management at the AESE Business School in 1995 and did a MBA at Universidade do Porto in 2003. He has a vast work experience, having served as Manager and Member of the Board at SONAE from 1984 to 1998, a period during which he was also Member of the board of the Portuguese Association of Consultants (1995/1997). From 1998 to 2002, José Eduardo de Sousa was a Member of the Board and Industrial Manager at Cerealis, as well as Vice-President at the Portuguese Association of Cereal Flakes. Later, from 2002 to 2009, he worked as Entrepreneur and Manager at Spresso and TPF Planege and, from January 2010 to July 2014, as Director at Efacec Engenharia e Sistemas (Environment), being the leader of the Air Business Division for the Engineering, Procurement and Construction of HVAC systems, Tunnel Ventilation, Energy Efficiency and Air Pollution Control. He was the Promotor of 5ensesinfood within a Cohitec program (2006), a company which he became General Manager of, in September 2014.

5ENSES INFOOD

"OATVITA, A Pre-Fermented Oat Cream for The Food Industry"

OATVITA is produced by 5ENSESINFOOD, S.A. a food industry start up, created in 2013 after a successful program at COTEC. OATVITA is a food ingredient composed by an oat fermented base (aqueous phase), soluble and adjustable to multiple applications with nutritional and soft claims. This ingredient integrates easily into most manufacturing conditions and can be used in a wide variety of applications, such as drinks, type-yogurts, ice creams or desserts. Derived from its proprietary process, OATVITA has unique organoleptic and texture properties namely clean taste, neutral colour, no graininess, smooth and creamy. When it is incorporated in an end-product OATVITA enhances and reinforces its taste and nutritious properties. The manufacturing process and composition of OATVITA are clean label, and it is not used any chemical or artificial additives. OATVITA is a multi-propose food ingredient that we can work at different incorporation rates according to the final desired application.

Session moderator

Miguel Amador

Miguel Amador is Manager of the HealthTech and NanoTech Programs at Startup Braga, an incubation and accelerator of new business in Braga, Portugal. He is also a Ph.D. student in Bioengineering Systems at Instituto Superior Técnico (IST) in Lisbon, under the MIT Portugal Program. As a Biomedical Engineer, he believes that innovation and entrepreneurship are the motors driving healthcare advancement, and he is using his engineering mindset to hack healthcare policy, and help to unlock precision medicine. His Ph.D. research focuses on new licensing regulatory frameworks to enable patient access to cell therapies. In 2014, he was awarded a Fulbright Fellowship to the MIT Center for Biomedical Innovation. He is also Vice-President of EIT Health Alumni, which aims to be the largest community of health innovators around Europe.

MIB/MEB™

Ana Matos

Ana Matos enrolled Bioengineering (and later Biological Engineering) in 2009/2010 at the best engineering school: FEUP. During the Master, although the classes were a great knowledge base, she felt the need to participate in 4 internships, 1 summer course and 1 soft skills training. She did her Erasmus internship in Brussels University in a Fermentation and Industrial Microbiology Laboratory, where she studies fermentation conditions of water kefir grains. Her master thesis was done in a spin-off company called IMPROVEAT, based in Minho University and it was focused on "Edible coatings for Raspberries" in order to extend their normally short shelf life time. At this time, it was becoming clear that she was not tailored for laboratory work, thus she decided to go bigger: search for an internship in a world-renowned food company. After many "NO"s, Ana was eventually accepted in Kraft Heinz Company (KHC) as intern. In 2016, Ana has come back to Portugal to finally graduate, while at the same time a position at KHC as Product Development Technologist was waiting for her in The Netherlands. Until now, she has been enthusiastically developing new products for the Dutch market.

Ana Luísa Torres

Ana Luísa graduated in Biomedical Sciences at the Faculty of Health Sciences of the University of Beira Interior (FCS-UBI) in 2009. Later, in 2011 she finished her MSc. in Biomedical Engineering, at the Faculty of Engineering of the University of Porto (FEUP). In this context, she started her research activities at INEB, under the supervision of Susana Santos and Marta Oliveira, working in the bone regeneration field. From 2011 to 2013 she was awarded with two Research Assistant fellowships, at FEUP and INEB, where she had the opportunity to continue her research. In January 2014, she was accepted in the BiotechHealth Doctoral Programme from Instituto Ciências Biomédicas Abel Salazar (ICBAS-UP) and awarded with a Doctoral Grant from FCT. Her PhD research project, which is entitled "Development of pre-vascularized injectable microspheres for ischemic tissue repair" is being performed at INEB, under the supervision of Cristina Barrias, in collaboration with Eduardo Silva, from University of California, Davis. Her research interests are related with Biomaterials and Regenerative Medicine. At the moment, she is mainly focused on the development of molecularly designed hydrogels that mimic the natural extracellular matrix, to produce injectable pre-vascularized microspheres for tissue repair. She is author of 3 articles in international peer-reviewed journals, 4 articles in international conference proceedings and 1 book chapter. She has 5 oral and 13 poster communications in scientific meetings.

Francisco Mendonça

Born and raised in Porto, Francisco graduated in Bioengineering at FEUP in 2013. During his degree, he participated in a research project as a King's College Erasmus' student at Guy's Hospital, and later he developed his master thesis research work on Gene Therapy at INEB. In 2014, Francisco started his career as a Functional Analyst and Consultant at Glintt, where he was given the opportunity to be involved in several healthcare IT projects, in Portugal major hospitals. He had the responsibility to meet the demands and expectations of clinical coordinators and managers, by solving their problems through the implementation of Glintt Clinical Solutions. Soon, he became fascinated by healthcare industry, particularly by hospitals' structure, processes and operations. Since November 2016, he has been working as a Production Manager at Hospital CUF Porto focused in process management and supervision, as well as in the development of KPIs at all levels of the organization.

Session moderator

Luis Melo

Luis F. Melo is a Chemical and Biological Engineering Full Professor at the University of Porto, Faculty of Engineering. He has over 30 years' experience in working on biofilm science and technology applied to cooling, drinking and process water, as well as wastewater treatment and, more recently, health systems. In the last 15 years, he was European coordinator or leader of the Portuguese team in 7 European projects. He is the Head of the Biological Engineering Laboratory (BEL) at the research unit LEPABE (Laboratory for Process Engineering, Environment, Biotechnology and Energy, FEUP). He was the Head of LEPABE (previously called LEPAE) from 2001 to 2013 and the Director of the Bioengineering Integrated Master at the Faculty of Engineering until 2013. He was vice-president of the Portuguese National Board for Science and Technology (presently named Science and Technology Foundation-FCT) in 1994-96, director of two NATO international Advanced Study Institutes on Fouling (1988) and on Biofilms (1992), chairman of the IWA (International Water Association) specialized conference on Biofilm Monitoring (2002) and of the Biofilms7 International Conference in 2016. He is the author or co-author of about 120 papers in refereed journals and around 20 invited chapters in international books, as well as the editor or co-editor of three books. His research interests include mainly the fields of Biofilm Science and Engineering, Heat Exchanger Fouling, Biological Wastewater Treatment and Drinking Water Systems.

1. "Prevention of catheter-related infections using graphene-based materials"

Inês Borges, Patrícia C. Henriques, Artur M. Pinto, Fernão D. Magalhães, Inês C. Gonçalves

Abstract:

Catheter insertion is commonly performed in critically ill patients for vascular access, however they are associated with a high risk of infection. In fact, catheter- related infections can be lethal and lead to patient's hospitalization and morbidity. They represent the third leading cause of hospital-acquired infections, being also associated with elevated medical costs. 1 Taking this together with the fact that bacteria resistance to antibiotics is continuously increasing, it becomes obvious the urgent need of a new biomaterial for the development of antimicrobial catheters to prevent catheter-related infections. So far, the existing strategies to convey antibacterial properties to catheters are still ineffective or present disadvantages. Meanwhile, since its discovery in 2004, graphene and graphene-based materials (GBMs) have excited researchers from several different areas. In particular, the biocompatibility and antimicrobial properties of these materials have a huge potential when it comes to biomedical applications. This work focuses on the antibacterial potential of graphene-based materials, in particular graphene nanoplatelets (GNP), for the development of a biomaterial for catheter production. The effect of nanoplatelets size and oxidation was evaluated, using GNP with two different lateral sizes (5 and 15 μm). In the biomaterials development, GNP were used to modify polyurethane (PU), the polymer most commonly used for catheter manufacture. For that two different strategies were explored: i) polyurethane composites with GNP as nanofillers, produced by melt- blending with different GNP content and ii) GNP-containing coatings on PU substrates, produced by dip coating with different GNP concentrations and PU:GNP weight ratios. The antibacterial properties of the produced materials were tested towards Staphylococcus epidermidis, the Gram-positive bacteria responsible for most of the catheter-related infections. SEM and XPS revealed that oxidation of GNP was successfully performed. The antimicrobial properties of the GNP suspensions were evaluated by colony forming units (CFUs) counting and metabolic activity evaluation. These studies showed that oxidized GNP have stronger antibacterial activity than non-oxidized GNP and that smaller particle size improves the antibacterial properties. Optical microscopy, SEM and contact angle measurements revealed that PU/GNP composites showed a good dispersion of GNP in the polyurethane matrix but no significant modification of the surface. Antibacterial assessment of the surface, performed according to the standard ISO 22196, revealed that the incorporation of GNP by melt-blending produced no significant effects on bacteria attachment, metabolic activity or viability. On the other hand, the PU/GNP-M and PU/GNP-Mox coatings showed increased GNP exposure at the surface comparing with the melt-blending composites. Oxidized GNP-containing coatings induced higher antibacterial effect towards S. epidermidis than the non- oxidized forms, either through anti-adhesive or bactericidal activity, depending on the GNP concentration used. Overall, this work highlights the potential of using GBMs as nanomaterials to confer antibacterial properties to polyurethane, and therefore as a promising strategy to develop a biomaterial for catheters with reduced risk of infection.

2. "Piezoelectric cardiac patch to improve electrical conduction on a rodent model of myocardial infarction"

Monteiro, Luís; Vasques-Nóvoa, Francisco-Gouveia, Pedro; Pinto-do-Ó, Perpétua Ferreira, Lino, Nascimento, Diana

Abstract:

Ischemic heart diseases are the leading cause of death worldwide. Acute myocardial infarction (MI) involves ischemia-induced cardiomyocyte death and the formation of a non-functional scar tissue at the infarcted site, impairing cardiac function, often leading to heart failure. In heart failure, arrhythmias are common events and account for 50% of sudden cardiac deaths. Although novel approaches involving gene and/or cell therapy or tissue engineering have been focusing on improving cardiac function, reducing cardiac remodelling or restoring cardiac electrical integrity, in vivo studies assessing therapeutic alternatives that promote concurrent contractile and electrical functional repair are scarce. Piezoelectric materials exhibit an electric polarization upon mechanical stress or vice-versa. Since the heart exhibits robust cyclic movements, the implantation of these materials on an injured myocardium holds great potential as could be possible to obtain a sustainable electrical activity with a consequent improvement of electrical integration of the material and cardiac function. In this work, the therapeutic potential of thin films of polycaprolactone (PCL) covered in polyvinylidene fluoride–trifluoroethylene (PVDF-TrFE) piezoelectric fibers ("Piezo patches") for the treatment of MI was evaluated by implanting them in the hearts of mice subjected to MI. Following one month, functional and histological characterization were performed. The materials induced an exacerbated inflammatory reaction associated with multinuclear inflammatory cells, resembling a foreign body reaction. Furthermore, although no significant differences were observed concerning echocardiography (relative to systolic function) and cardiac tissue remodelling, a consistent tendency for improvement was observed in the Piezo patch-treated animals. Of note, electrocardiograms showed that these animals exhibited an enhanced myocardial conduction with evidences of having a reduced ventricular arrhythmia susceptibility, when compared with films containing non-conductive PCL fibers. Thus, the herein work supports the use piezoelectric materials as an innovative tissue engineering conductive scaffold and/or to be used in combination with other therapies towards restoration of electrical integrity upon MI.

3. "Molecular tools to tackle protein aggregation in Machado-Joseph disease"

Ana Almeida, Alexandra Silva, Zsuzsa Sárkány, Sandra Macedo-Ribeiro

Abstract:

Machado-Joseph Disease (MJD) is a neurodegenerative disorder, included in the group of polyglutamine (polyQ) expansion diseases, caused by a mutation resulting in the expansion of a polyglutamine segment in the protein ataxin-3 (atx-3). This protein functions as a deubiquitinase and turns pathogenic whenever its polyQ tract exceeds a threshold of 55 glutamines. Enzymatic activity is ensured by a globular domain, the Josephin Domain (JD), which is followed by a flexible C-terminus containing two or three protein ubiquitination motifs and the polyQ. The Josephin Domain contains aggregation-prone regions required for the initial steps of aggregation, which mechanism is independent of the polyQ repeats. A few macromolecular interacting partners of atx-3 that modulate aggregation rates by shielding the aggregation-prone regions of the Josephin domain have been identified. Nanobodies, the antigen-binding domain derived from camelid heavy-chain antibodies, are promising tools in biotherapeutics. They are also excellent tools to probe protein aggregation due to their high affinity, specificity and stability. Nanodbodies targeting atx-3 Josephin domain have been produced and tested as tools to interfere with protein self-assembly. The interaction of NB01 with both non-expanded (13Q) and expanded (77Q) isoforms of atx-3 is in the nanomolar range with the former showing a higher affinity, as determined by Isothermal Titration Calorimetry (ITC). The effect of one of these nanobodies (NBD01) on aggregation of atx-3 isoforms was monitored by Thioflavin T (Tht T) fluorescence assay, revealing that it interferes with Atx-3 self-assembly. The morphology of the atx-3 amyloid fibrils also changes in the presence of NBD01, as observed by Transmission Electron Microscopy (TEM), suggesting that this molecule exhibits a great potential for further studies and development of future therapies tackling MJD pathologies.

4. "PP1 inactivates MPS1 to ensure efficient Spindle Assembly Checkpoint silencing"

M. Moura, M. Osswald, N. Leça, J. Barbosa, C. E. Sunkel, C. Conde

Abstract:

Faithfull genome partitioning during cell division relies on the Spindle Assembly Checkpoint (SAC), a conserved signalling pathway that delays anaphase onset until all chromosomes are correctly attached to the mitotic spindle. MPS1 kinase is a well-established upstream regulator of the SAC pathway. MPS1 becomes active in early mitosis as a result of its T-loop autophosphorylation. However, the mechanism controlling MPS1 inactivation once the SAC is satisfied remains unknown. In this study, we demonstrate in vitro and in vivo that PP1 dephosphorylates MPS1 T-loop to render the kinase inactive. Furthermore, we show that PP1-mediated dephosphorylation of MPS1 occurs at kinetochores as well as at the cytoplasm, and the inactivation of both pools of MPS1 is required for timely SAC silencing. Thus, our findings contribute to understand how cells regulate MPS1 and expose a requirement for its cytosolic inactivation to allow prompt SAC silencing.

5. "Mps1 phosphorylates BubR1 to promote Spindle Assembly Checkpoint signalling"

S. Silva, M. Osswald, M. Moura, C. Sunkel, C. Conde

Abstract:

Each time a cell divides it must distribute one copy of the duplicated genome into each daughter nucleus. Errors in chromosome partitioning often lead to aneuploidy, a hallmark of cancer and cause of birth defects. The Spindle Assembly Checkpoint (SAC) is a surveillance mechanism thatensures correct chromosome segregation in mitosis by restraining anaphase onset until all chromosomes are correctly attached to spindle microtubules. Mps1 and BubR1 are key SAC proteins that accumulate at unattached kinetochores to catalyse the assembly of the Mitotic Checkpoint Complex (MCC), a diffusible inhibitor of the anaphase-promoting complex/cyclosome (APC/C) and consequently, of mitotic exit. However, the mechanisms underlying MCC assembly remain unclear. In this work, we show that Mps1 phosphorylates BubR1 at Serine 518. Expression EGFP-BubR1 S518A phosphodefective mutant in S2 cells resulted in premature anaphase onset and compromised SAC function upon microtubules depolymerisation. Moreover, preventing BubR1 S518 phosphorylation led to a decrease in Cdc20 levels at unattached kinetochores. Importantly, pull-down assays with recombinant proteins indicate that phosphorylation of BubR1 on the S518 residue promotes its binding to Cdc20, even in the absence of Mad2. Collectively, these results support a model in which Mps1 phosphorylates BubR1 at S518 to increase BubR1 affinity for Cdc20 which we found to be required for sustained SAC function.

6. "Coupled Hidden Markov Model for Automatic ECG and PCG Segmentation"

J. Oliveira, C. Sousa, M. Coimbra

Abstract:

Automatic and simultaneous electrocardiogram (ECG) and phonocardiogram (PCG) segmentation is a good example of current challenges when designing multi-channel decision support systems for healthcare. In this. paper, we implemented and tested a Montazeri coupled hidden Markov model (CHMM), where two HMM's cooperate to recreate the "true" state sequence. To evaluate its performance, we tested different settings (two fully connected and two partially connected channels) on a real dataset annotated by an expert. The fully connected model achieved 71% of positive predictability (P+) on the ECG channel and 67% of P+on the PCG channel. The partially connected model achieved 90% of P+on the ECG channeland80% of P+ in the PCG channel. These results validate the potential of our approach for real world multichannel application systems.

7. "Real-time Anterior Mitral Leaflet Tracking using Morphological Operators and Active Contours"

Malik Saad Sultan, Nelson Martins, Eva Costa, Diana Veiga, Manuel João Ferreira, Sandra Mattos and Miguel Tavares Coimbra

Abstract:

The mitral valve plays a vital role in our circulatory system. To study its functionality, it is important to measureclinically relevant parameters, such as its thickness, mobility and shape. Since manual segmentation is impractical, time consuming and requires expert knowledge, an automatic segmentation tool can have a significant clinical impact, providing objective measures to clinicians for understanding the morphology and behaviour of the mitral valve. In this work, a real-time tracking method has been proposed for ultrasound videos obtained with the Parasternal Long Axis view. The algorithm is semi-automatic, assumes manual Anterior Mitral Leaflet segmentation in the first frame and then it uses mathematical morphology algorithms to obtain tracking results, further refined by localized active contours during the whole cardiac cycle. Finally, the medial axis is extracted for a quantitative analysis. Results show that the algorithm can segment 1137 frames extracted from 9 fully annotated sequences of the real clinical video data in only 0.89 sec/frame, with an average error of 5 pixels. Furthermore, the algorithms exhibited robust tracking performance in the most difficult situations, which are large frame-to-frame displacements.

8. "A Comparative Analysis of Deep and Shallow Features for Multimodal Face Recognition in a Novel RGB-D-IR Dataset"

Tiago Freitas, Pedro G. Alves, Cristiana Carpinteiro, Joana Rodrigues, Margarida Fernandes, Marina Castro, João C. Monteiro, Jaime S. Cardoso

Abstract:

With new trends like 3D and deep learning alternatives for face recognition becoming more popular, it becomes essential to establish a complete benchmark for the evaluation of such algorithms, in a wide variety of data sources and non-ideal scenarios. We propose a new RGB-depth- infrared (RGB-D- IR) dataset, RealFace, acquired with the novel Intel® RealSense™ collection of sensors, and characterized by multiple variations in pose, lighting and disguise. Asbaseline for future works, we assess the performance of multiple deep and "shallow" feature descriptors. We conclude that our dataset presents some relevant challenges and that deep feature descriptors present both higher robustness in RGB images, as well as an interesting margin for improvement in alternative sources, such as depth and IR.

9. "Rapid detection of contaminant microorganisms in microalgae reactors by fluorescence in situ hybridization (FISH)"

Joana Silva Pinto, Andreia S. Azevedo, Noreen Hiegle, Tiago Guerra, Nuno F. Azevedo

Abstract:

Microalgae are photosynthetic organisms that convert water and carbon dioxide into biologically-active compounds. One of many industrially interesting microalgae is Haematococcus pluvialis which can produce high levels of astaxanthin, a ketocarotenoid considered to be one of the most valuable algal compounds in the market, with applications in cosmetics, pharmaceutics, nutraceuticals and animal feed. Although the production levels of microalgae at industrial-scale has increased over the years, the appearance of pathogens that harm production also augmented, leading to a strong interest in the study of harmful contaminants. Hoffman et al. (2008) first described Paraphysoderma sedebokerense, as "Haematococcus parasite". Fungal contamination by chytrid-like organisms has been recognized as one of the most serious impediments for natural astaxanthin production from H. pluvialis. In order to evaluate the quality of microalgae production, plating methods and PCR-based methods are generally used. Results obtained by plating assays can take up to 3 days while PCR based methods require the extraction of DNA from the cell. During this work, a peptide nucleic acid-based (PNA) probe was developed in order to rapidly detect the contaminant microorganisms by fluorescence in situ hybridization (FISH). In contrast to PCR-based methods, FISH allows the detection of the whole cell. In this particular case, the probe was used for the detection of the fungal parasite P. sedebokerense in Haematococcus cultures. The PNA probe was designed from gene sequences available at GenBank. As a control, available sequences of the closest relatives, and other organisms that might be present in the photobioreactor were added to the dataset. Sequences were aligned with Clustal Omega to select possible regions for probe design. The selection of the probe sequence was based on regions that showed differences between the P. sedebokerense sequences to the non-target strains. Additionally, sensitivity- and specificity-criteria were included for the selection of the PNA probe, including a high pyrimidine content, an absence of self-complementary structures, a Gibbs free energy around -13 kcal/mol and a melting temperature around 70 °C. The selection of the fluorophore was based on its maximum excitation and emission and the availability of suitable fluorescence microscope filters. The selected probe sequence was ordered with a 5' FAM fluorophore attached, from Panagene. FISH process development included optimisation of different parameters such as: hybridisation temperature and solutions as well as fixation and permeabilization steps in axenic culture. In the future, we will test the detection of P. sedebokerense in infected Haematococcus cultures. Detection limits of FISH will be tested by fluorescence microscopy and additionally by flow cytometry or with a plate reader. The established assay will then be applied on Haematococcus cultures infected with a defined Paraphysoderma inoculum and infection will be followed in a time-course experiment. Eventually the developed technique will be tested for outdoor Haematococcus cultures at pilot-scale.