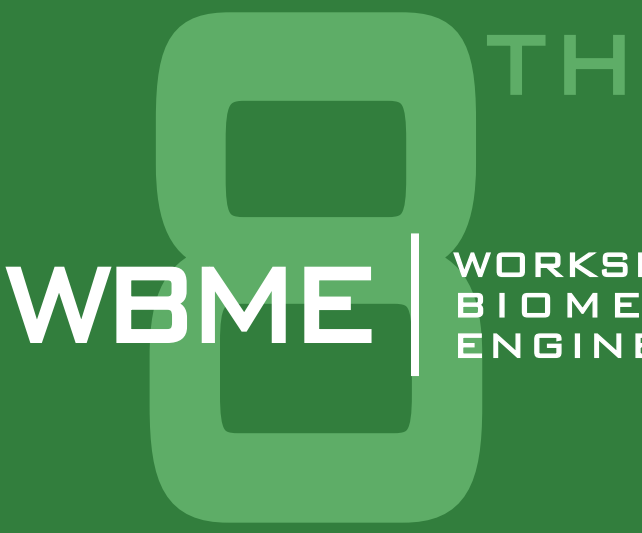
The University of Lisbon

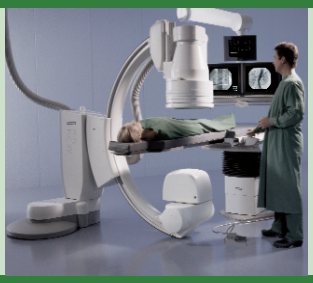


8TH WBME | WORKSHOP ON BIOMEDICAL ENGINEERING

http://wbme.fc.ul.pt

PROGRAM

9h00 – 9h20	**Welcome Session**
9h20 – 10h00	Gabriel Martins
10h00 – 10h40	Axel Thielscher
10h40 – 11h00	***Coffee Break***
11h00 – 11h30	Best Abstract
11h30 – 12h45	Forum “What is the role of a Biomedical Engineer in the business World?”
12h45 – 14h00	***Lunch break***
14h00 – 14h40	Andreia Gaspar (Best Alumni)
14h40 – 15h20	Iñaki Iturrate
15h20 – 16h00	Diana Prata
16h00 – 16h40	**Coffee Break + Poster Session**
16h40 – 17h20	Dennis Schaart
17h20	Best Poster Announcement
17h20 – 17h30	Break
17h30 – 18h30	Workshop: Unity by Hugo Ferreira
17h30 – 18h30	Workshop: "Just do it! A quick lesson on entrepreneurship" by Teclabs



The main objective of this annual Workshop is to expose students, engineers and scientists to recent developments in Biomedical Engineering that took place in some of the most respected international research centres and universities. Due to the great variety of Biomedical Engineering subjects, each year only a few will be contemplated. The 2016 edition will concentrate on Transcranial current stimulation (tCS), Mesoscopic imaging, Brain-machine Interfaces (BMIs), Echo Planar Imaging (EPI) MRI and neuroimaging in social behaviours.

This 8th edition of the WBME will also include a forum on "What is the role of a Biomedical Engineer in the business World?", and like last year, a poster session will take place at this edition, which will allow you to get in touch with the latest advances in Biomedical Engineering. There will also be a prize for the best abstract submitted.

We hope this workshop will stimulate portuguese and foreign students to contact directly with researchers from some of the best universities in the world and learn about their experience abroad. In this way we may contribute to open new opportunities for research and collaboration in this fascinating area that is giving a major contribution to the great transformations which are taking place in modern Medicine.

Speakers

Andreia Gaspar

MRes Student at Medical Imaging Centre for Doctoral Training King's College London – Division of Imaging Sciences and Biomedical Engineering – London, United Kingdom

"Improving fetal and neonatal echo-planar imaging with image-based shimming"

Biography:

Andreia Gaspar received her M.Sc. Degree in Biophysics and Biomedical Engineering from the University of Lisbon in Portugal, in 2015. During her B.Sc. she had contact with image processing techniques of cardiac magnetic resonance imaging (MRI), and during the last year worked in MRI image acquisition of the perinatal brain at King's College London. Andreia is currently a MRes student on Medical Imaging at King's College London, and her research interests include MRI acquisition and reconstruction.

Abstract:

Echo planar imaging (EPI) is the magnetic resonance imaging method of choice to obtain functional and diffusion-weighted images of the human brain. This technique allows fast volumetric coverage of the whole brain, but is associated with susceptibility artefacts. In order to minimize those artefacts it is necessary to reduce the main magnetic field B0 inhomogeneities – this process is known as B0 shimming.

B0 shimming is particularly challenging in the context of fetal and neonatal imaging. The babies' brain suffers changes in dimension and shape during its development from fetal to neonatal age. In each one of those stages the baby is surrounded by a different environment which requires a distinct shimming approach.

B0 shimming methods made available by the manufacturer are fast, but have two main disadvantages in this context. First, in order to be fast, the field mapping is based on projections, increasing errors in regions with high field variation. Second, they do not account for the effects of shimming a small region of interest, like the fetal brain, on the surrounding structures in which it is immersed.

In this talk, I will present an image-based shimming tool to minimize susceptibility artefacts in neonatal and fetal EPI images, which overcomes the previously referred limitations.

Axel Thielscher

Assoc. Prof., Danish Research Center for Magnetic Resonance, Copenhagen University Hospital Hvidovre & Technical University of Denmark, Kgs. Lyngby

"To what extent can we invert source imaging methods to calculate electrode positions for tACS or tDCS?"

Biography:

Axel Thielscher obtained doctoral degrees in Electrical Engineering and Biomedical Sciences, both "with highest honor", from the University of Ulm (Germany). This was followed by a PostDoc stay at Brown University (Providence, RI) and a position as research group leader at the Max-Planck-Institute for Biological Cybnernetics (Tübingen, Germany). Currently, Axel holds a shared position as Associate Professor at the Danish Research Center for Magnetic Resonance (Copenhagen University Hospital Hvidovre, Denmark) and the Technical University of Denmark (Kgs. Lyngby).

Axel's methodological research foci are on the modeling of biophysics of transcranial brain stimulation and on combined neurostimulation-neuroimaging approaches. He was among the first to employ finite-element simulations of high spatial resolution to characterize the electric field induced by transcranial magnetic stimulation (TMS), resulting in a novel hypothesis on the stimulation mechanisms of TMS. This work resulted in the first open-source toolbox for high-resolution field calculations in brain stimulation (www.simnibs.org), which is now available in a second strongly improved version. He further has a strong expertise in combining TMS with functional magnetic resonance imaging (both off- and online), with a focus on studying human sensorimotor integration and motor control processes.

Abstract:

Transcranial weak current stimulation (tCS) uses electrodes placed on the subject's scalp to generate weak electrical currents in the brain, in turn modulating the neural activity in gray matter. A variety of methods have been proposed for optimizing the intensity or focality of electric fields generated by tCS, most involving the costly calculation of dozens of FEM models at various electrode positions. The electric fields, however, follow the Laplace Equation, which places a constraint in how focal the electrical fields can ultimately be. I will revisit the underlying theory, as well as give examples based on simple spherical models and high resolution head models to demonstrate the physical limits on stimulation focality and discuss the inherent trade-off between stimulation focality and intensity at the cortical target site. I will demonstrate that optimizing tCS montages for specific cortical targets can significantly improve focality and intensity. However, it is important to be aware that there are fundamental physical limitations on how good the optimized solution can get.

Dennis R. Schaart
Delft University of Technology
Radiation Science & Technology department, Mekelweg 15
2629 JB Delft – The Netherlands

"Emerging Detection Technologies in Positron Emission Tomography"

Biography:

Dennis R. Schaart is an expert on in-vivo molecular imaging technologies for diagnostic and (radio-)therapeutic applications. He has experience in the medical device industry as well as academia. While working at Nucletron (now Elekta) on new devices for radiotherapy he wrote a PhD thesis in private time on the subject of intravascular brachytherapy, for which he obtained his doctoral degree (with highest honors) at Delft University of Technology. He then joined the university to set up a new research line on in vivo molecular imaging technology. Today, his main research interests include novel instruments for time-of-flight positron emission tomography (TOF-PET), PET/MRI, and particle therapy. His team was among the first to explore the use of silicon photomultipliers (SiPMs) in TOF-PET. In 2009 they achieved a world-record coincidence resolving time of < 100 ps FWHM in the detection of annihilation photon pairs with SiPMs. They also were the first academic group to use so-called digital SiPMs (dSiPMs) in PET applications. This led to the development of the first fully-digital monolithic scintillator PET detector, which offers unprecedented imaging performance and was awarded with a Best International Abstract Award at the 2015 Society of Nuclear Medicine and Molecular Imaging Annual Meeting (SNMMI 2015). Dennis is a Member of the IEEE Nuclear and Medical Imaging Sciences Council (NMISC), has (co-)authored more than 75 journal papers, numerous conference contributions, and is a frequent invited speaker.

Abstract:

Almost a century after George de Hevesy introduced the radiotracer principle for studying molecular targets and pathways in living organisms without perturbing them, positron emission tomography (PET) is a widely used tool for in vivo molecular imaging. PET is commonly combined with CT to simultaneously obtain functional and anatomical information. Recently, also the integration of PET and MRI has been made possible by the introduction of solid-state photosensors such as the silicon photomultipliers (SiPM). Clinically, PET is already used in the individualized diagnosis, staging, treatment planning, response monitoring, and follow-up of patients with cancer. Moreover, there remains a large potential for PET in the research, diagnosis, and personalized treatment of neurological, cardiovascular, infectious, and inflammatory diseases. However, this requires that we further reduce the radiation dose, scan time, and costs per patient, as well as improve the compatibility of PET with other modalities. Amongst others this can be achieved by exploiting the principle of time-of-flight (TOF) imaging, which has been shown to significantly improve PET image quality. Current research in Delft aims at further pushing the limits in TOF-PET imaging and the realization of cost-effective, high-performance digital PET detectors for PET/CT and PET/MRI systems. This talk will present the general principles of PET, the status of the current research activities, and an outlook on future developments in clinical molecular imaging.

Diana Prata

Group Leader, Instituto de Medicina Molecular (iMM Lisboa), Faculdade de Medicina, Universidade de Lisboa (FMUL) Visiting Lecturer, Centre for Neuroimaging Sciences, Institute of Psychiatry (IoP), King's College London (KCL), UK

"When neuroimaging, genetics and psychiatry get social"

Biography:

Diana Prata became a biologist at the University of Lisbon in 2002. She then moved to the Institute of Psychiatry of King's College London (KCL) where she obtained her PhD in neuroimaging genetics in 2008. She then coordinated a joint-venture between KCL and a pharmacogenetics company, and later did post-doctoral research at the National Institute for Health Research, UK, and became a Lecturer at KCL. She then came back to the University of Lisbon to seed a research group, focused on the neurobiology of human behaviour, at the Institute of Molecular Medicine (iMM Lisboa), as an FCT-investigator, with the support of a Marie Curie Career Integration grant. Her work has involved combining genetics with neuroimaging and currently focus on the attempt to build a genetic/imaging/environmental biomarker for psychosis, and on the biological basis of social cognition and its impairment.

Abstract:

How does our brain work out what others are thinking or feeling? What physiological mechanisms drive us to interact, or not, to others? Societies cannot survive without trust and cooperation, and lack of this type of social behaviour is in fact both cause and consequence of several mental illnesses.

Understanding the biology behind social cognition is key to improve wellbeing and psychiatric treatments. We will explore neuroimaging, genetic and neuropharmacological techniques others and we employ, in humans, to understand cognitive processing in health and illness, and highlight recent discoveries elucidating if and how the oxytocin system mediates human pro-social drive, trust, cooperation and affiliative behavior.

Gabriel G Martins
Instituto Gulbenkian de Ciencia, R. Quinta Grande,
6, 2780-156 Oeiras

"Open source mesoscopic imaging and the frontier between bio & medical imaging"

Biography:

Graduated in Biology in 1994 from FCUL, did my PhD in Anatomy and Cell Biology from the SUNY Buffalo – NY. In 2004 I returned to Portugal to teach Developmental Biology at the Instituto Piaget – Almada. In 2006 I started a post-doc at FCUL, and in 2008 I became a researcher at the Centre for Environmental Biology (CBA/FCUL), and as a manager of the FCUL's Microscopy Facility. I have authored articles and book chapters on developmental/cell biology and Bioimaging.

I run FCUL's Master's class on Bioimaging since 2007, and have participated and organized several national and international advanced courses on microscopy. Currently I am the head of the "Advanced Imaging" facility of the Instituto Gulbenkian de Ciencia in Oeiras.

Abstract:

A standing challenge in developmental biology is the study of morphogenetic processes in vivo and in toto, ie, inside whole embryos/organisms. With conventional microscopy techniques it is only possible to observe cellular details on thin tissues, typically 1-to-few cell layers, and 3D imaging of larger tissues, often in vivo, is only possible using confocal or 2p microscopy. However, these techniques do not allow deep observation in the range of a few mm ("Mesoscopic imaging"). Two recent techniques have come to aid in imaging both fixed and live thick specimens: optical tomography (aka OPT) and light-sheet microscopy. However, commercial solutions are scarce or inexistent (for OPT), and few prototypical systems are available. Here we present a fully open-source, low-cost solution for mesoscopic imaging based on the OpenSpin Microscopy platform (Gualda E et al 2013; Nature Methods 10: 509-510). The implementation of such systems requires only some basic knowledge of optics and electronics, and is fully open source. We will also present examples of large datasets and open-source solutions for processing, displaying and sharing these datasets.

Iñaki Iturrate

Defitech Foundation Chair in Brain-Machine Interface (CNBI), Center for Neuroprosthetics (CNP) of the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

"Brain-machine interfaces: from prosthetic control to motor rehabilitation"

Biography:

Iñaki Iturrate is a Marie Curie post-doctoral fellow at the Defitech Foundation Chair in Brain-Machine Interface (CNBI), Center for Neuroprosthetics (CNP) of the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. He holds an MS (2009) and a PhD (2014) in Computer Science and Robotics from the University of Zaragoza, Spain. His research focuses on the study of new non-invasive and semi-invasive brain correlates that can be applied to realistic assistive and rehabilitation scenarios by means of brain-machine interfacing.

Abstract:

Brain-machine Interfaces (BMIs) provide a way to bypass conventional channels of communication (i.e. muscle or speech) by the use of users' brain signals. A BMI monitors and translates their intentions into commands without activating any muscle or peripheral nerve. Proof-of-concept BMIs have been already demonstrated in several contexts and online scenarios, either with healthy participants and people with severe motor disabilities such as stroke or spinal cord injury (SCI). Among these applications, most common ones are those of restoring communication and control (e.g. spelling devices), motor substitution (e.g. control of neuroprosthesis for reaching and grasping), entertainment (e.g. gaming), and motor recovery (e.g. BCI-driven upper-limb therapy for stroke). This talk will cover the basics of non-invasive via electroencephalography (EEG) brain-machine interfacing, from the acquisition and feature extraction to the application layers of the system.

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