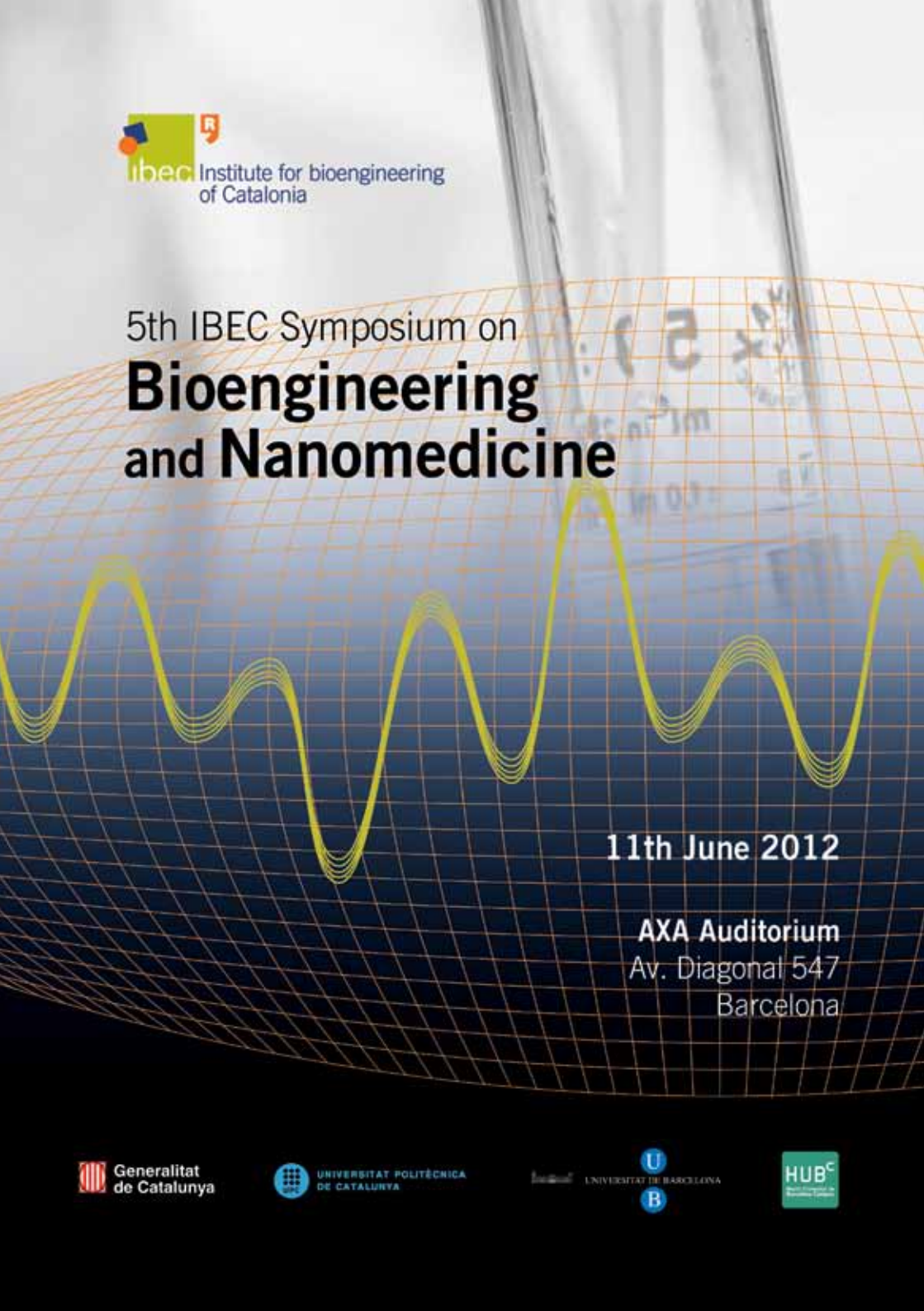
ibec
Institute for bioengineering
of Catalonia
5th IBEC Symposium on
Bioengineering
and Nanomedicine
11th June 2012
AXA Auditorium
Av. Diagonal 547
Barcelona
Generalitat
de Catalunya
UNIVERSITAT POLITÈCNICA
DE CATALUNYA
UNIVERSITAT DE BARCELONA
HUB

5th IBEC Symposium on

Bioengineering and Nanomedicine

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Welcome to IBEC's fifth annual symposium on Bioengineering and Nanomedicine.

The symposium is our yearly opportunity to present our research publicly and to showcase some of the achievements of international experts in our many fields of interest.

This year our keynote speakers, who are specialists in a diverse range of research areas, are a true reflection of IBEC's multidisplinary nature. In addition, participants can enjoy 26 flash presentations from our young researchers and PhD students covering an even wider range of topics.

Along with the poster sessions and networking opportunities offered by the coffee and lunch breaks, the symposium once again promises to be an invaluable forum to review the state-of-the-art in bioengineering and nanomedicine and promote interdisciplinary discussion.

Enjoy the day!

Josep A. Planell, Director of IBEC

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Bioengineering and Nanomedicine

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Information for participants

Information Desk

The conference registration and information desk will be located in the main reception hall of the AXA Auditorium. It will be staffed from 08:00 to 18:30 on Monday 11th June.

Badges

Each registered participant will receive a name badge. For security reasons, the badge must be clearly exhibited in order to access the congress area during all scientific and social events. Replacements for lost badges will be available from the registration desk.

Speakers/Flash presentations

Speakers and those participants giving flash presentations should take their presentation(s) to the reception desk during the coffee or lunch break before their session. Those who are speaking in the first session in the morning should go to the desk at least 15 minutes before the start of the day's programme.

Poster sessions

Posters should be hung during registration between 08:00 and 09:00 on Monday 11th June. Please refer to the information board in the registration area or this book to check which board number has been allocated to you.

Posters can remain on display throughout the conference and should be removed between 18:00 and 18:30. Any posters remaining after the indicated time will be removed by the organizers, who accept no responsibility for loss or damage.

Poster sessions will take place during the coffee and lunch breaks.

Certificate of attendance

If you wish to have a Certificate of Attendance, you can request one from the Secretariat at symposium@ibecbarcelona.eu.

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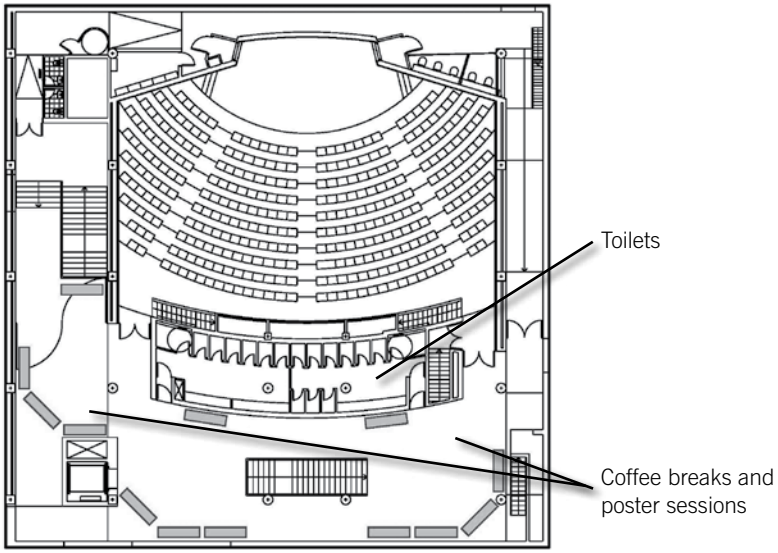
Venue plan and location map



Programme

Monday, 11th June	
08:30-09:00	Registration
09:00-09:30	Opening ceremony
09:30-10:05	**Prof. Bradley Nelson**, ETH Zürich *Microrobotics and nanomedicine*
10:05-11:00	Flash poster presentations I
11:00-11:50	Coffee break & Poster Session
11:50-12:25	**Prof. Antonio Juárez**, IBEC *Tackling antibiotic resistance: interaction between resistance plasmids and their bacterial hosts*
12:25-13:00	**Prof. William Bonfield**, University of Cambridge *Achieving clinical and commercial success with biomaterials start-ups*
13:00-14:15	**Lunch & Poster Session**
14:15-14:50	**Prof. Conrad Bessant**, University of Cranfield *Pattern recognition for medical diagnostics*
14:50-15:45	Flash poster presentations II
15:45-16:40	Coffee break & Poster Session
16:40-17:15	**Prof. Xavier Trepat**, IBEC *Forces, waves and traffic jams during collective cell migration*
17:15-17:50	**Prof. Alejandro F. Frangi**, Sheffield Uni./Univ. Pompeu Fabra *Image-based cardiovascular modeling for advanced diagnosis and interventional planning*
17:50-18:00	Awards and Closing Ceremony

KEYNOTE LECTURES

Monday, 11th June 9:30

Microrobotics and nanomedicine

Bradley Nelson
Swiss Federal Institute of Technology (ETH Zürich), Switzerland

The futuristic vision of micro- and nanorobotics is of intelligent machines that navigate throughout our bodies searching for and destroying disease, but we have a long way to go to get there. Progress is being made, though, and the past decade has seen impressive advances in the fabrication, powering and control of tiny motile devices.

Much of our work focuses on creating systems for controlling micro- and nanorobots in liquid as well as pursuing applications of these devices. Larger scale microrobots for delivering drugs to the retina to treat eye diseases such as age-related macular degeneration and retinal vein and artery occlusion are moving towards clinical trials. As size decreases to the nanoscale, we have been inspired by motile bacteria such as *E. coli*, and have developed nanorobots that swim with a similar technique. Applications we pursue at these scales are for the treatment of breast cancer and cerebral infarctions.

The potential impact of this technology on society is high, particularly for biomedical applications, though many challenges remain in developing micro- and nanorobots that will be useful to society. An overarching requirement for achieving breakthroughs in this area is the need to bring together expertise from a wide variety of science and engineering disciplines. Robotics brings expertise in the planning and control of mechanisms with many degrees of freedom in uncertain environments. Nanotechnology teaches innovative approaches to fabricating nanoscale machines. In addition, biomedical imaging advances are needed, as is fundamental insight into the nature of fluid dynamics at very small scales. Medical professionals must be tightly integrated into the development cycle, and experts in developing business models and intellectual property must be closely consulted.

As systems such as these enter clinical trials, and as commercial applications of this new technology are realized, radically new therapies and uses will result that have yet to be envisioned.

Prof. Bradley Nelson

Professor Bradley Nelson *is Professor of Robotics and Intelligent Systems at ETH Zürich. His primary research focus is on microrobotics and nanorobotics with emphasis on applications in biology and medicine. He received a B.S.M.E. from the University of Illinois at Urbana-Champaign and an M.S.M.E. from the University of Minnesota. He worked as an engineer at Honeywell and Motorola and served as a United States Peace Corps Volunteer in Botswana before obtaining his PhD in robotics from Carnegie Mellon University in 1995. He was an Assistant Professor at the University of Illinois at Chicago (1995-1998) and an Associate Professor at the University of Minnesota (1998-2002), and became a Full Professor at ETH Zürich in 2002.*

Prof. Nelson has received more than a dozen Best Paper awards at major robotics conferences and journals. He was named among 2005's "Scientific American 50," Scientific American magazine's annual list recognizing outstanding acts of leadership in science and technology, for his efforts in nanotube manufacturing. His laboratory won the 2007 and 2009 RoboCup Nanogram Competition and appears in the 2012 Guinness Book of World Records for the 'Most Advanced Mini Robot for Medical Use'. He has served as head of the ETH Department of Mechanical and Process Engineering, chairman of the ETH Electron Microscopy Center, and is a member of the Research Council of the Swiss National Science Foundation. He also serves on the editorial boards of several journals.

Notes

Tackling antibiotic resistance: interaction between resistance plasmids and their bacterial hosts

Antonio Juárez
Institute for Bioengineering of Catalonia (IBEC)

Nowadays, infectious diseases remain the second-leading cause of death worldwide. Spreading of antibiotic resistance is hence life-threatening in the same sense as cancer. Two main factors are underlying spreading of antibiotic resistance: the ability of bacterial cells to readily acquire genes from other organisms (horizontal gene transfer, HGT) and the selective pressure imposed by the sometimes indiscriminate use of antibiotics. Bacterial plasmids are autonomously replicating genetic elements that can be horizontally transferred within a population. In many instances, these elements facilitate HGT of multiple antibiotic resistance (MAR). We have studied the role of a group of plasmids (IncHI1) that confers MAR in the pathogenic bacterium *Salmonella*. Global transcriptomic analysis were performed in *Salmonella* cells with and without R27 plasmid (the best studied and prototype of IncHI1 plasmids), either actively growing at low (25ºC) or high (37ºC) temperature, or entering the stationary phase. The expression of more than 700 chromosomal genes is affected by the presence of the plasmid in *Salmonella* cells growing at low temperature and entering the stationary phase. The functions of many of these genes are relevant for an optimal adaptation of these bacteria to survive in natural environments. At least one global modulator, the nucleoid-associated protein H-NS, has been identified as responsible for altering the expression of some of these genes. The participation of other modulators is now being investigated.

These studies evidence that, out of conferring MAR, the presence of IncHI1 plasmids in *Salmonella* has a strong impact in the biology of these cells: plasmid-harboring cells are better adapted to survive outside their hosts. We propose targeting any of the global mododulators that mediate the interaction between IncHI1 plasmids and the chromosome as a future means of combating MAR in *Salmonella*.

Prof. Antonio Juárez

Bacterial molecular geneticist ***Professor Antonio Juárez*** *obtained his PhD in biology in 1980 from the University of Barcelona. He conducted his postdoctoral research at the Institut für Genetik und Mikrobiologie at the Universität Würzburg, Germany between 1981-1983, before taking up the position of Associate Professor in microbiology at the University of Barcelona in 1984. He became full professor there in 1983 and has been a group leader at IBEC since 2007.*

His main area of research interest has been the identification and characterization of bacterial nucleoid associated proteins that modulate gene expression in response to environmental stimuli. Presently his group is focusing on four main areas: 1. studying the mechanisms modulating virulence expression in enteric bacteria using the model organisms E. coli *and* Salmonella *to gain insight into the mechanisms that enable bacterial pathogens to express virulence determinants and cause infection; 2. antimicrobial resistance and bacterial plasmids, also in* E. coli *and* Salmonella *and using IncHI1 plasmids, to understand the role that some resistance plasmids play in bacterial adaptation; 3. the application of nanotechnologies to better understand the bacterial cell at the single cell level, using AFM to electrically characterize them; 4. Lab-on-a-chip: using dielectrophoresis chips to improve sensitivity of PCR-based detection methods of single cells.*

Notes

Achieving clinical and commercial success with biomaterials start-ups

William Bonfield
Department of Materials Science and Metallurgy, University of Cambridge, UK

Advances in regenerative medicine are critically dependent on the innovation of second-generation biomaterials which are favourably bioactive, rather than simply bioinert in a given *in vivo* situation, through control of the biological processes in adjacent tissues. For skeletal tissues, effective three-dimensional regeneration is enhanced by precursor scaffolds, which combine appropriate surface chemistry and topography with optimized interconnecting macro- and microporosity. Two examples are considered in which novel biomaterials scaffolds have been translated from laboratory concepts to clinical applications. First, the development of a silicon-substituted calcium phosphate, which enhances rapid and ordered bone remodeling as a bone graft substitute, and has achieved major clinical application for spinal fusion and other orthopaedic procedures. Second, the design of a controlled collagen-glycosaminoglycan-calcium phosphate system, which allows a generic approach to cartilage repair. These distinctive technologies have produce both benefits for patients and exceptional growth opportunities for the associated start-up companies.

Prof. William Bonfield

Professor William Bonfield *is Emeritus Professor of Medical Materials at the University of Cambridge, where he established and directed the Cambridge Centre for Medical Materials and the Pfizer Institute of Pharmaceutical Materials Science. He was educated at Imperial College, receiving an engineering degree with First Class Honours, the Perry Memorial Medal for distinction in Mathematics and Mechanics and the Bessemer Medal for distinction in Metallurgy, followed by a PhD. He then worked as a Senior Research Scientist at the Honeywell Research Centre in Minneapolis, before returning to the UK as Reader in Materials Science at Queen Mary College. Subsequently he became Professor of Materials, Head of the Department of Materials, Chairman of the School of Engineering and Dean of Engineering. At Queen Mary, he created and became Director in 1991 of the University of London Interdisciplinary Research Centre (IRC) in Biomedical Materials, the first of its kind in the UK.*

His awards include the Royal Academy of Engineering Prince Philip Gold Medal, the Royal Society Armourers and Brasiers Company Medal, the Kelvin Medal, the European Society for Biomaterials George Winter Award, the Japanese Society for Biomaterials Medal, the Institute of Materials Griffiths Medal and Chapman Medal, the UK Society for Biomaterials President's Prize, the Acta Metallurgica H. H. Holloman Award and the International Union for Physical Sciences and Engineering in Medicine Award of Merit. He has been elected to all three UK National Academies as a Fellow of the Royal Society (FRS), a Fellow of the Royal Academy of Engineering (FREng) and a Fellow of the Academy of Medical Sciences (FMedSci).

He founded two successful MedTech companies, OrthoMimetics Ltd (now TiGenix) and Apatech Ltd, which last year was acquired by global healthcare company Baxter, and in 1998 was appointed Commander of the British Empire (CBE) by the Queen for his services to healthcare and materials science.

Pattern recognition for medical diagnostics

Conrad Bessant
Bioinformatics Group, Cranfield Health, University of Cranfield, UK

Modern analytical devices such as spectrometers, electronic noses and other sensor arrays are able to rapidly acquire large amounts of data about the composition of biological samples. However, converting these complex data sets into meaningful diagnostic outcomes that can be used by clinicians presents a number of challenges. Foremost among these is the ability to recognise disease-specific biochemical patterns in the presence of complex biological noise.

This talk will provide an overview of current methods for tackling this pattern recognition problem, using as examples Cranfield's recent work in the diagnosis of *Mycobacterium tuberculosis*, bladder cancer and breast cancer. Particular topics to be covered include (i) the relative merits of the two main approaches – multivariate statistics and machine learning, (ii) the importance of selecting to most appropriate clinical samples to train a pattern recognition system, and (iii) how to calculate performance metrics that give the most representative indication of how well the diagnostic method will perform in clinical practice.

Dr. Conrad Bessant

Dr. Conrad Bessant *is currently Reader in Chemometics and Bioinformatics at Cranfield University in the UK. He holds a first degree in physics and a PhD in chemometrics. Dr Bessant's primary research interest is the development of algorithms and software for the automated interpretation of data from highly multivariate analytical techniques, such as mass spectrometry, vibrational spectroscopy and sensor arrays (e.g. electronic nose). Applications of this work currently underway in the group include biomarker discovery, medical diagnostics, food quality studies and systems biology.*

Dr Bessant is also active in teaching, having established Cranfield's popular MSc in Applied Bioinformatics. He has published over 60 peer reviewed journal articles and is lead author of the popular textbook Building Bioinformatics Solutions.

Notes

Monday, 11th June 16:40

Forces, waves, and traffic jams during collective cell migration

Xavier Trepat
Institute for Bioengineering of Catalonia (IBEC)

A broad range of biological processes such as morphogenesis, tissue regeneration, and cancer invasion depend on the collective motion of cell groups. For a group of cells to migrate cohesively, it has long been suspected that each constituent cell must exert physical forces not only upon its extracellular matrix but also upon neighboring cells. I will present the first techniques to measure these distinct force components. Using these techniques, we unveiled an unexpectedly rich physical picture in which the distribution of physical forces is dominated by heterogeneity, cooperativity, and jamming. I will show, moreover, that these essential features of inter-cellular force transmission enable the propagation of a new type of mechanical wave during tissue growth. Finally, I will demonstrate that both in epithelial and endothelial cell sheets, forces and waves are mechanically linked to cell velocities through a newly discovered emergent mechanism of innately collective cell guidance: plithotaxis.

Prof. Xavier Trepat

Professor Xavier Trepat *received a BSc in physics in 2000 and a BSc in engineering in 2001. In 2004 he obtained his PhD from the Medical School at the University of Barcelona. He then joined the Molecular and Integrative Physiological Sciences program at Harvard University as a postdoctoral researcher. In 2008 he became a Ramon y Cajal researcher at the University of Barcelona and the Institute for Bioengineering of Catalonia (IBEC), and in January 2011 he became an ICREA Research Professor. His research at IBEC focuses on integrative tissue dynamics and cytoskeletal mechanics.*

Notes

Image-based cardiovascular modeling for advanced diagnosis and interventional planning

Alejandro F. Frangi
University of Sheffield/Universitat Pompeu Fabra

Current technological progress in multidimensional and multimodal acquisition of biomedical data enables detailed investigation of the individual health status that should underpin improved patient diagnosis and treatment outcome. However, the abundance of biomedical information has not always been translated directly in improved healthcare. It rather increases the current information deluge and desperately calls for more holistic ways to analyse and assimilate patient data in an effective manner.

The Virtual Physiological Human aims at developing the framework and tools that would ultimately enable such integrated investigation of the human body and rendering methods for personalized and predictive medicine.

This lecture will focus on and illustrate two specific aspects: a). how the integration of biomedical imaging and sensing, signal and image computing and computational physiology are essential components in addressing this personalized, predictive and integrative healthcare challenge; and b). how such principles could be put at work to address specific clinical questions in the cardiovascular domain.

Finally, this lecture will also underline the important role of model validation as a key to translational success and how such validations span from technical validation of specific modeling components to clinical assessment of the effectiveness of the proposed tools. To conclude, the talk will outline some of the areas where current research efforts fall short in the VPH domain and that will possibly receive further investigation in the upcoming years.

Prof. Alejandro F. Frangi

Professor Alejandro Frangi *obtained a degree in Telecommunications Engineering from the Technical University of Catalonia (Barcelona) in 1996 and pursued his PhD on model-based cardiovascular image analysis at the Image Sciences Institute of the University Medical Center Utrecht. During this period he was visiting researcher at Imperial College London and at Philips Medical Systems BV in The Netherlands. Prof. Frangi was Ramón y Cajal Research Fellow and Assistant Professor at the Universidad de Zaragoza from 2001-2004, after which he moved to Barcelona and the Universitat Pompeu Fabra. where he is currently Associate Professor, as well as Professor of Biomedical Image Computing at the University of Sheffield (USFD), UK, and an ICREA-Academia Researcher. He leads the Center for Computational Imaging & Simulation Technologies in Biomedicine at the UPF and is member of the INSIGNEO Institute for Biomedical Imaging & Modelling. Prof. Frangi is a recipient of the IEEE Engineering in Medicine and Biology Early Career Award in 2006, the Prizes for Knowledge Transfer (2008) in the Information and Communication Technologies domain and of Teaching Excellence (2008, 2010) by the Social Council of the Universitat Pompeu Fabra.*

Notes

POSTERS


Posters presentations
ibec
1 Agudo Gangolells, Idoya Breath Analysis by Ion Mobility Spectrometry in COPD and Lung Cancer Patients
2 Aguirre, Aitor PLA/Bioactive Glass Composite Enhances Endothelial Progenitor Cell Angiogenesi
3 Artés, Juan Manuel Implications for in situ Tissue Engineering Applications
4 Barreiros dos Santos, Marília Electron transfer properties of redox protein azurin measured
Tunneling Spectroscopy
5 Basomba, Joan Development of a high performance nanobased multianalyte
pathogens

Posters

Shading = flash presentation

1	Zaida Alvarez	Aligned polylactic acid nanofibers induce inmature phenotypes on brain cortex cells *in vitro* and *in vivo*
2	Juan Manuel Artés	Wired molecular transistor based on single protein junctions
3	Milad Avazbeigi	Integrating various odor response data into a common response model base on minimizing global prediction error using Tabu-Search
4	Elsa Bazellières	Intercellular force propagation across cell-cell junctions during collective cell migration
5	Maria Bulwan	Ultrathin thermoresponsive polymer nanocoatings for cell encapsulation
6	Annalisa Calò	Force spectroscopy on natural vesicles from *Saccaromyches cerevisiae*
7	Cristina Casas	Microfluidic platform for neuroscience research with embedded temperature control
8	Maria del Mar Cendra	H-NS as a novel transcriptional modulator for the ribonucleotide reductase genes in *Escherichia coli*
9	Vito Conte	Modelling mechanical-wave propagation in epithelial expansion
10	Laura Corredor	New bioactive electrospun nanofibers with embedded Ca/P nanoparticles for angiogenesis promotion in bone and skin regeneration
11	Juan Crespo	Functionalization of electrospun polymeric nano-structured fibers for tissue regeneration
12	José Antonio del Río	Neural stem cell proliferation and differentiation in the adult CNS: a role for the cellular prion protein?
13	Claudia Di Guglielmo	Studying the differentiation of human and human induced pluripotent stem cells to cardiomyocytes reporter transgenic cell line
14	Manuela Dietrich	Characterization of proteins specific to *Enterobacteriaceae*
15	Aurora Dols-Pérez	Nanomechanical properties of lipid raft models in dry environment

Posters

16 Daniel Esteban	Single bacteria hydrophobicity/hydrophilicity studied using Electrostatic Force Microscopy
17 Manel Frigola	CT- 3D ultrasound image registration framework for patient localization in medical robotics
18 Teresa Galán	From thin layers to micro- and nanopatterning of biocatalytically produced polypyrrole for biosensor applications
19 Vanessa Gil	NeuroMEMS (I): Developing new culture platforms to monitor neural repair
20 Laura González	Biological samples imaging with tuning fork based nanosensors in ambient and liquid conditions
21 Georg Gramse	Nanoscale dielectric polarizability of biomembranes and insulating thin films imaged and quantified in electrolyte solutions
22 Veronica Hortigüela	Self-assembled nano-patterned surfaces for the study of the effects of ligand clustering on cells
23 Mario Hüttener	3D carbon-electrode dielectrophoresis as a rapid sample preparation tool for improved PCR analysis
24 Merce Izquierdo	Optical modulation of neurotransmission
25 Senda Jiménez	Genetic cell ablation of specific cell types in the zebrafish
26 Anita Kosmalska	A new cell stretching device allowing the tracking of the dynamics and force generation of focal adhesions
27 Riccardo Levato	Improving biological response of PLA microcarries via covalent surface grafting of collagen
28 Montse López	Electronic properties of electrochemical and bioelectrochemical systems studied by differential conductance ECSTM
29 Carol López-Quesada	Microfluidic biosensor based on localized surface plasmon resonances for early cancer detection
30 Tomás Luque	Nanomechanics of decellularized lung matrix probed with Atomic Force Microscopy

Posters

31 Yassine Maazouz	Fabrication of flexible calcium phosphate scaffolds by robocasting
32 Andrea Malandrino	The effect of endplate calcification on pH levels and cell viability in the intervertebral disc
33 Paula Marañón	Encapsulation of ciprofloxacin within poly-(lactic-co-glycolic acid) (PLGA) nanoparticles enhances efficacy against bacterial pathogens in biofilm
34 Elena Martínez	Cell motility in gradients: competition between topographical ratchet and chemical adhesion
35 Andrés Martín-Quirós	Spatiotemporal regulation of clathrin-mediated endocytosis with light
36 Josep Mas	Optical force measurements in living A549 cells
37 Joana Mesquita	Characterization of respiratory and spontaneous arousals in patients with Sleep Apnea-Hypopnea Syndrome
38 Sergio Mora	Chondrogenic differentiation of human induced pluripotent stem (iPS) cells in bioactive scaffolds
39 Mireia Oliva	Self-assembled polyelectrolyte complexes as nanocarriers for enzyme replacement therapy in the treatment of Fabry disease
40 Sergio Oller	MCR-ALS applied to GC-IMS olive oil measurements
41 Carlos Parra	Selective *in situ* functionalized biosensor for human serum albumin on LOC
42 Xavier Puñet	Elastin-like recombinamers for surface functionalization
43 Vijay Rajasekaran	Modelling and controlling an orthotic system using a High Level Controller
44 Lorena Redondo	AFM force-clamp monitors the lipid bilayer failure kinetics
45 Pilar Rodríguez	Nanostructured surfaces of broad area with high throughput biosensing capabilities

Posters

46 Adriana Rodríguez-Marí	Zebrafish as a model to understand the genetic mechanisms of heart regeneration
47 Carlos Ruiz	Strategies to cope with fluid velocity instabilities in intervertebral disc poroelastic models
48 Nadège Sachot	Engineered polymeric surfaces: a new protocol to coat electrospun nanofibers with bioactive glasses
49 Leonardo Sarlabous	Adaptive attenuation of the cardiac vibration interference in mechanomyographic signals
50 Xavier Serra-Picamal	Mechanical waves during tissue expansion
51 Isil Tekeli	Using photo-inducible CreERT2 recombinase system to study zebrafish cardiac regeneration
52 Maria Tintoré	DNA origami for the study of structure-dependent interactions between thrombin and thrombin-binding aptamers (TBA)
53 Eduard Torrents	Rapid, *in situ* and non-destructive method to characterize biofilm formation by stylus and optical profilometry
54 Themis Toumanidou	On the constitutive modelling of the lumbar spine musculature
55 Oiane Urra	Improving diagnostic tools: beyond the reach of apnea hypopnea index
56 Juan José Valle-Delgado	Self-assembly of human amylin-derived peptides into amyloid fibrils of nanotechnological interest
57 Maria Valls	Cardiac tissue engineering: bioengineering heart muscle
58 Cristina Vergara	BESAD-P. Molecular screening of a cell-penetrating cis-γ-amino-l-proline-derived peptides as inhibitors of Ab production *in vitro*
59 Manuel Vinagre	Human activity recognition for improving robot-assisted living
60 Rosa Letizia Zaffino	DNA hybridization detection through mediated charge transport electrochemical nano-sensor

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