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Seminars

RECENT

Microcrack distributions
in bone: effects of stress
and bone mineral
density

Dr. Gerardo Presbitero
Trinity College Dublin

Date: Friday 9 September
2011

Time: 4.00pm

Venue: Crossland Theatre,
Parsons Building, Trinity
College

UPCOMING

Measuring the
mechanical properties of
brain for impact
simulation

John Finan
Columbia University

Date: 27 September 2011

Time: 4.00pm

Venue: Printing House,
Trinity College Dublin

Message from the Director

The Summer and early autumn has seen TCBE Researchers presenting at numerous conferences and workshops. It has been a very busy time. There has been an increase in our participation this year, highlighting the increase in our research activities. The end of the summer also sees the final completion of the new Trinity Biomedical Sciences Institute. As a result some of the research and also administration activities of the Trinity Centre for Bioengineering will be moving to this new facility in October.

We welcome Dr Conor Buckley as a new PI in the Centre. Dr Buckley's current main research area focuses on the development of strategies to regenerate the intervertebral disc (IVD) using mesenchymal stem cells (MSCs). Other research areas include tissue engineering technologies, design and development of bioreactor systems, characterisation of nutrient micro-environments, biomaterial interactions and 3D scaffold construct technology



The International European Society of Engineering and Medicine Summer School organized and hosted by the Trinity Centre of Bioengineering, was a resounding success for the third year. We are now seeing many of these high quality students returning to Trinity and registering on our MSc in Bioengineering. The MSc in Bioengineering itself in its 12th year commenced on 5th September with a total intake of 25 students, 7 of these focusing on the specialist programme in Neural Engineering.

With regard to our research activities, this has been reflected in the Government's Research Prioritization exercise. This report has highlighted that "Health, Wellbeing and Ageing" be one of five major areas for support across all Irish Government research agencies. TCBE was explicitly mentioned in the report out as having excellent research collaboration with clinical colleagues. This collaboration has led to innovative solutions in diagnostics and interventions. Some of latest innovative solutions will be on display in the Science Gallery on the evening of the 6th October as part of the Trinity College's Innovation and Technologies Showcase.

Paul R. Butler

NEW GRANTS

Title: Tough healable hydrogels
Programme: Science Foundation Ireland: Research Frontiers 2011–2015
PI: Dr. Biqiong Chen.
Budget: €170,600

Title: Development of a cannabinoid eluting scaffold for orthopaedic tissue engineering strategies
Programme: SFI Research Frontiers Programme (2011–2015)
PIs: Prof. Veronica Campbell with Prof Kevin Mulhall (Sports Surgery Clinic) and Prof Fergal O'Brien (RCSI) as collaborators:
Budget: €192,100.00

AWARDS

Martin Frydrych has been awarded with a TCD Postgraduate Research Studentship to develop novel tissue scaffolds with Dr. Biqiong Chen. Martin has obtained an MSc degree from the University of Applied Sciences, Darmstadt (Germany) and carried out his MSc thesis in Trinity on "Biocompatible cellular and non-cellular gelatin-matrix composites".

Nikoletta Adler is currently in Dr Alice Witney's lab on a Wellcome Trust Summer Vacation Scholarship.

Congratulations to Tara McFadden, a PhD student in Prof. O'Brien's group, on her first successful grant. Tara was recently awarded an SFI Short Term Travel Fellowship (€10,800) which will be used to fund a 3 month placement in Prof. Robert Guldberg's lab in Georgia Tech. Tara will be moving to Atlanta in August.

SEMINARS & KEYNOTES

Dr. Biqiong Chen gave an invited research forum on "structure-property relationships of polymer-matrix nanocomposites" in the Materials & Surface Science Institute at the University of Limerick.

SEMINARS & KEYNOTES

Prof. Reilly gave the keynote talk titled "Combining technologies and methods for improved clinical understanding of ageing" at the 53rd Annual Irish Gerontological Society Conference on 9th September 2011

NEW RECRUITS

Neural Engineering welcomes 3 new PhD students, Gerard Loughnane, who has a Bachelor's degree in computer science from UCD and a HDip in Psychology from TCD, he will be working on multisensory integration. James O'Sullivan, who has a Bachelor's degree in Electronic Engineering from UCD and is just completing the MSc in Bioengineering (again through UCD), will be working on improving methods for assessing visual processing in humans using data driven models. Martin Holmes has a Bachelor's degree in Biomedical Engineering from UL and will be working on Acoustic Analysis of Respiratory Sounds for Assessment of Pulmonary Function

News from Dr. Simms group:

Eamonn McKnight has been nominated for the Fusion graduate of the year award 2011. Eamonn is an Intertrade Ireland Fusion graduate who worked on the walking aid Dr. Simms developed in collaboration with Moorings Mediquip.

Sara Dockrell, from the Department of Physiotherapy, has just started a PhD with Dr Simms on safe load limits for schoolbags for children.

Mathew Lyons joins Dr Simms team in September as a PhD student with IRCSET funding working on the development of a wound closure device for laparoscopic surgery.

CONFERENCES ATTENDED

Members from the Neural Engineering group attended the **33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC '11)** in Boston, Massachusetts, USA. This conference which took place from 30 August to 2 September covered a range of diverse topics from biomedical engineering to healthcare technologies to medical and clinical applications. Dr. Edmund Lalor delivered a talk on Comparing linear and quadratic models of the human auditory system using EEG. It was about constructing computational models of auditory processing in humans – a much neglected area – and looked to quantify the quality of these models with a view to applying them to clinical research. It took place in a session on Brain Physiology and Modeling which included speakers from Imperial College London, Harvard, MIT and Johns Hopkins University.

Hugh Nolan presented results from an EEG study of motion. These results detailed the use of an oddball paradigm to present motion stimuli and elicit a standard response, which has not been seen using motion before. Ehsan Chah presented results of a study examining the variability neurons' action potential waveforms, more commonly known as spikes. The result of this study has important implication in the design of spike sorting methods. Prof. Reilly, Dr. Lalor and Hugh also participated in a workshop on "Dynamic Nonlinear Modeling of Neural Ensemble Activity".

WELL DONE

Congratulations to Tatiana Vinardell who successfully defended her PhD this month. The title of her thesis was "An investigation of joint tissue derived stem cells for articular cartilage tissue engineering".

PAPERS AND PUBLICATIONS

Nagel, T., Kelly, D.J. Mechanically induced structural changes during dynamic compression of engineered cartilaginous constructs can potentially explain increases in bulk mechanical properties. *Journal of the Royal Society Interface* (in press).

Haugh, M.G., Meyer, E.G., Thorpe, S.D., Vinardell, T., Duffy, G.P. and Kelly, D.J. Temporal and Spatial Changes in Cartilage-Matrix Specific Gene Expression in Mesenchymal Stem Cells in Response to Dynamic Compression. *Tissue Engineering Part A* (in press).

Ahearne, M., Buckley, C.T., Kelly, D.J. A growth factor delivery system for chondrogenic induction of infrapatellar fat-pad derived stem cells in fibrin hydrogels. *Biotechnology and Applied Biochemistry* (in press).

Kasiri, S., Kelly DJ. An Argument for the Use of Multiple Segment Stents in Curved Arteries. *Journal of Biomechanical Engineering* (in press).

S. Liu, S. Jeannes, B. Chen: Nanofibrous Bacterial Cellulose/Chitosan Scaffolds: Preparation, Structure and Mechanical Properties. *Journal of Biomaterials and Tissue Engineering*. In Press (in the special issue published by the editorial members).

Cox G, McGonagle D, Boxall SA, Buckley CT, Jones E, Giannoudis PV.
The use of the reamer-irrigator-aspirator to harvest mesenchymal stem cells
J Bone Joint Surg Br. 2011 ;93(4):517-24.

Elliot JR, Simms CK, Wood DP, "Pedestrian head translation, rotation and impact velocity: The influence of vehicle speed, pedestrian speed and pedestrian gait", in press, *Journal of Accident Analysis and Prevention*, July 2011.

KM Moerman, CK Simms, AM Sprengers, J Stoker and AJ Nederveen, Validation of SPAMM Tagged MRI Based Measurement of 3D Soft Tissue Deformation, *Medical Physics*, 38 (3), 1248-12

Early, M., Kelly D.J. The consequences of the mechanical environment of peripheral arteries for nitinol stenting. *Medical and Biological Engineering and Computing* (in press).

Tsanov M., Chah E, Vann S.D., **Reilly R.B.**, Erichsen J.T., Aggleton J.P., O'Mara S.M., Theta-Modulated Head Direction Cells in the Rat Anterior Thalamus, *Journal of Neuroscience*, 31(26):9489-9502, June 2011.

Setti A, Finnigan S., Sobolewski R., McLaren L., Robertson I.H., **Reilly R.B.**, Kenny R.A., Newell F.N., "Audiovisual temporal discrimination is less efficient with ageing: An ERP study", *NeuroReport*, Vol 22, Iss 11, 554-558, August 2011

Foran TG, Ni Scanail C, Greene B, O'Donovan K, **Reilly R.B.**, Kenny R.A., "Testing For Determinism In Gait Data In Fallers Using Body Worn Inertial Sensor", *Proceedings of the European Medical Physics and Engineering Conference*, Dublin, Sept 2011.

Hermann S., Reilly, R.B., Power D. "Novel method for detection of blood flow in both young and older subjects at rest, as a model for identifying risk of pressure ulcers in vulnerable movement-restricted elderly subjects", *Proceedings of the 7th Congress of the European Union Geriatric Medicine Society, also the Proceedings of the 53rd Congress of the SEGG and the Proceedings of the 32nd Congress of the SAGG*, Malaga, September 2011

Chah E., Hok V., O'Mara S.M., **Reilly R.B.**, "A Waveform Independent Cell Identification Method to Study Long-term Variability of Spike Recordings", *Proceedings of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, August 2011.

Power A., **Reilly R.B.**, Lalor E. "Comparing linear and quadratic models of the human auditory system using EEG", *Proceedings of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, August 2011.

Nolan H., Butler J., Whelan R., Foxe J.J., **Reilly R.B.** "Motion P3 Demonstrates Neural Nature of Motion ERPs", *Proceedings of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, August 2011.

Cervigon Abad R., **Reilly R.B.**, Castells F.V., "Principal Component Analysis to Quantify Anaesthetic Effects on Atrial Fibrillation Morphology", *Proceedings of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, August 2011.

TCBE PEOPLE & ACTIVITIES

PUBLICITY

Press Release for ESEM Summer School

Thirty engineering, medical and biomedical engineering undergraduate students from across Europe are designing next generation medical devices at the Trinity Centre for BioEngineering at Trinity College Dublin as part of the European Society for Engineering and Medicine (ESEM) Summer School this week (July 11th –22nd). This is the third year for this unique European summer school, organised in collaboration between eight leading universities in biomedical engineering and medicine, apart from Trinity College Dublin these are the University of Groningen (NL), Ghent University (B), Brno University of Technology (CZ), Czech Technical University in Prague (CZ), RWTH University Aachen (D), University of Regensburg (D) and the Royal College of Surgeons in Ireland (IRL).

“Current healthcare challenges, such as the ageing of Europe’s population as well as big killers such as cardiovascular disease, require multidisciplinary approaches for diagnosis and treatment. The focus therefore of this unique summer school is to establish a platform of cooperation between medicine and engineering across Europe starting at an undergraduate level,” explained Professor Richard Reilly, Director of the Trinity Centre of BioEngineering and organiser of the Summer School.

With different working cultures and educational backgrounds, the aim of the European Society for Engineering and Medicine Summer School at Trinity College has been to teach students how to work together efficiently by getting small groups to design new, novel medical devices targeting specific medical and clinical problems. These include the design of a system to monitor a patient’s weight and risk of sarcopenia on a daily basis, technologies to screen for aorta aneurisms, designing systems to preserving mobility of patients and looking at how to move rehabilitation treatments to the home situation.

To have the educational basis to undertake this challenge, the students are taking courses delivered by 15 leading Professors of Biomedical Engineering and Medicine, who also join the students at Trinity College.

The medical students are instructed in bioengineering methods (materials science, mathematics, biomechanics, signals and systems) necessary to successfully work in biomedical engineering while engineering students are instructed in anatomy and physiology at the Royal College of Surgeons in Ireland. Both groups of students are taught design methodologies for furthering their understanding and capability to understand, analyse and successfully conceptualise innovative medical device concepts using a multidisciplinary team approach.

“We want future biomedical engineers and clinicians to understand each other’s discipline,” said Professor Bart Verkerke of the Department of Biomedical Engineering at the University Medical Center Groningen.

“The impact of this summer school has been to ignite enthusiasm and passion among undergraduate engineers and medical students for the challenges and opportunities in bioengineering,” continued Professor Richard Reilly, Director of the Trinity Centre of BioEngineering and President of the European Society of Engineering and Medicine. “This Summer School coincides with the opening of the new Trinity Biomedical Sciences Institute at Trinity College, within which there is a new centre for Advanced Medical Device Design”.

“There are currently over 11,000 medical technology companies in Europe, investing some €5.8 billion in R&D, exporting €65 billion worth of products annually and employing 500,000 people. It is critical that we can demonstrate to these students that engineering innovation and creative design can meet the challenges in healthcare, continue the growth of medical device sector and the delivery of the best medical care possible,” concluded Professor Reilly.

Students participating in the summer school are learning in a unique environment which was reflected in their comments of the programme:

“I am learning the differences in culture between medics and engineers. And I am learning to follow the Methodological Design Method for generating ideas concerning a specific problem and to optimise the organisation of a multidisciplinary project team.”

“The ESEM summer school will give me the opportunity to improve my knowledge of engineering in medicine and healthcare, meet other students from different countries and discuss with them in a constructively critical atmosphere.”

“I am amazed by what can be done and the directions one can take with this specialisation. I also have gained an overall understanding of modelling and simulation.”

‘I gained a lot of knowledge from the medical environment provided through the ESEM Summer School and the participating professors. It helped me carry out our project and to understand other participants’ projects as well. “

The outcome of the collaboration will lead to continued interaction of the students throughout their undergraduate and also postgraduate career through the network established by ESEM. The novel project outcomes will be published on the society’s website (www.esem.org) to further disseminate to the medical device industry and wider community.

This is the 3rd Summer School organised by the Trinity Centre for BioEngineering at Trinity College Dublin with the European Society for Engineering and Medicine (ESEM). Professors Verkerke and Reilly both highlighted that fact that students from previous Summer Schools are now successful postgraduate students in biomedical engineering programs at different universities across Europe, such as the new Erasmus Mundus MSc in Biomedical Engineering. This underscores the benefit of the Summer School in providing extra knowledge but more importantly increased awareness of educational and career opportunities to those interested in biomedical engineering and medical device design.

Erasmus Mundus MSc in Biomedical Engineering postgraduate programme is also organised by the same consortium of European universities as the Summer School and is focused on preparing students for an international career in Biomedical Engineering.

The 2012 ESEM Summer School is already being planned and scheduled. There is considerable opportunity for the medical device sector to get involved in the Summer School and participate in the lectures and project assignments. Interested industries can contact Prof. Reilly (tcbe@tcd.ie).

TCBE PEOPLE & ACTIVITIES

Some photos from ESEM Summer School 2011



Summer School participants group shot



Summer School Professors and lecturers



Tour to Glendalough



Tour to Glendalough



Presentation of certificate to Aoife Duignan



Winning Teams for Medical Device Designs

RESEARCH OPPORTUNITY

Applications are invited for a post-doctoral researcher in orthopedic biomechanics in a project entitled **Modulating bone quality during fracture repair in osteoporotic bone**. at the Department of Orthopedics, Lund University, Sweden. This project will evaluate the ability of new potent bone modulating drugs to enhance repair in normal and osteoporotic bone in an animal model. For more information, questions, contact: Hanna Isaksson, Ph.D., Assistant Professor Biomechanics, Solid Mechanics / Orthopedics, Lund University, Box 118, 221 00 Lund, Sweden Email: hanna.isaksson@solid.lth.se,

PUBLICITY

In the most recent edition of Heart News, the newsletter of the Irish Heart Foundation, there is a feature on Dr Duffy and the Microbubble technique being employed by his group. This treatment involves targeting cardiac tissue at the onset of heart failure with Microbubbles which are loaded with therapeutic molecules. These molecules can then begin to repair the damage and reduce cardiomyocyte hypertrophy.

In the August Edition of *Irish Medicines Board, Medical Devices Newsletter* a feature article detailed the current state of the art of tissue engineering and identified the groups central role in the area of bone, cartilage and cardiovascular regenerative medicine. The article was written by Prof. Fergal O'Brien, Dr Tanya Levingstone, Dr Ciara Murphy and Dr Orlaith. [Click here](#) to view the article.

NEURAL
ENGINEERING



REGENERATIVE
MEDICINE



BIOMATERIALS



MUSCULOSKELETAL



CARDIOVASCULAR



Measuring the mechanical properties of brain for impact simulation

Dr John D. Finan
Columbia University

Date: Tuesday 27 September 2011

Time: 4.00 pm (Coffee from 3.45pm)

Venue: Printing House, Trinity College Dublin

Abstract

Traumatic brain injury remains the leading cause of death among young people in the developed world. The brain is a phenomenally complex organ and head impact can damage a range of different anatomical structures within the brain, creating functional deficits that range from learning impairment to death. Unfortunately, the mechanics of brain tissue are challenging to measure and challenging to model so mechanical models of head impact must make simplifying assumptions that mask much of the diversity of clinical brain injury. As a result, the myriad of different pathological processes that combine to produce brain injury are difficult to separate from one another and difficult to understand. The goal of this work is to capture some of the heterogeneity of brain injury biomechanics by using indentation to measure the stiffness of different brain regions and demonstrate that the properties of brain tissue depend on the anatomical structure tested and the loading direction. Data from an existing indentation apparatus will be presented alongside plans to use atomic force microscopy to advance the experiment towards higher strain rates and larger strains that more closely model the mechanics of real head impact events.

Biography

John D. Finan received his Bachelor's degree in Mechanical Engineering from University College Dublin in 2001 before completing a Master's degree focused on helmet optimization at Duke University in 2005. He proceeded to earn a PhD. in Biomedical Engineering at Duke in 2010 studying the intracellular biomechanics of articular chondrocytes. Since 2010, he has been a postdoctoral scholar in the Neurotrauma and Repair Laboratory at Columbia University, studying brain injury biomechanics and exploring novel therapies for brain trauma.

