INSIGNEO Institute for *in silico* Medicine | The University Of Sheffield. | Sheffield Teaching Hospitals NHS Foundation Trust

Insigneo Newsletter - February 2021

Welcome to our monthly Insigneo newsletter!

Our monthly e-newsletter keeps you up to date with events, funding, success stories and information. We hope you will find it useful! If you would like to add information and/or events to this newsletter please email: news@insigneo.org (the newsletter will be issued during the 2nd week of the month, excluding January and August). Please ensure that you submit news and events with a minimum of one week's notice.

Welcome to new members

We would like to introduce some new members who have joined the Insigneo Institute recently. We are very pleased to welcome:

Dr Alice Pyne
Department of Materials Science & Engineering
UKRI/MRC Rutherford Innovation Fellow & Lecturer in Soft Matter/Polymer

Alice is an MRC/UKRI Innovation Fellow and Lecturer in Soft Matter/Polymers.

Prior to this, she was an independent research fellow at the London Centre for

Nanotechnology, UCL working closely with industry to develop high-resolution atomic force microscopy (AFM) technologies, able to resolve variations in the DNA double helix on a single molecule.

Alice is the speaker for our next Insigneo seminar on 'Base-pair resolution analysis of the effect of supercoiling on DNA structure and flexibility' on 19 February 2021.

Full profile

Professor Li Su
Department of Neuroscience
Professor of Neuroimaging

Professor Su was awarded a PhD in Computational Neuroscience from University of Kent in 2009.

After several years of postdoctoral research in the Institute of Psychiatry at King's College London, MRC Cognition and Brain Sciences Unit and University of Cambridge, he was awarded a highly competitive Senior Research Fellowship from Alzheimer's Research UK in 2017.

He leads the *Artificial Intelligence & Computational Neuroscience Group* (www.aicn-group.com), which aims to combine innovative and original computational methods with the state-of-the-art brain imaging techniques such as MEG/EEG, 7T MRI and PET in understanding, detecting and developing treatments for neurological and psychiatric conditions. He uses AI inspired models as 'virtual' patients to capture cognitive dysfunctions. Comparing the models with neuroimaging, clinical, VR and genetic data from real patients, one can obtain mechanistic understanding about not only 'what' has gone wrong in patients' brains but also 'why' they experience the symptoms. Ultimately, the models allow us to develop and test new drug treatments (*in-silico*) before they are experimented on humans speeding up drug developments.

In 2020, he was appointed Professor of Neuroimaging at the University of Sheffield. He also holds a part-time PI position in Department of Psychiatry at University of Cambridge. He leads the Alzheimer's Research UK East Network Centre and is an elected Fellow in Clare Hall, University of Cambridge. His research has been recognised through international awards including an I*nternational College of Geriatric Psychoneuropharmacology Junior Investigator Award* in 2015.

Full profile

Professor Ivan Minev
Department of Automatic Control and Systems Engineering
Professor of Intelligent Healthcare Technologies

Alice is an MRC/UKRI Innovation Fellow and Lecturer in Soft Matter/Polymers.

Ivan Minev studied Physics at Imperial College London graduating in 2008. He obtained his PhD degree from the University of Cambridge in 2012. Working in the group of Stephanie Lacour, he was involved in developing stretchable electronics. Between 2012 and 2016, Ivan was post-doctoral researcher at the Center for Neuroprosthetics at the Swiss Federal Institute of Technology in Lausanne (EPFL), developing soft implants for the nervous system. From 2016 to 2019, he was research group leader at the Biotechnology Center of Technische Universität Dresden, Germany.

Ivan joined ACSE in October 2019.

Full profile

Laura Saunders
Department of Infection, Immunity & Cardiovascular Disease
Postdoctoral Research Associate

I am working as a postdoc as part of the POLARIS research group, and my background is in MRI physics.

My research focuses on the technical and physiological mechanisms that affect quantitative cardiac and pulmonary MRI biomarkers, as well as developing novel free-breathing, proton MRI methods in patients with pulmonary vascular disease and lung disease.

Eve Lennie
Department of Infection, Immunity & Cardiovascular Disease
PhD Student - POLARIS Group

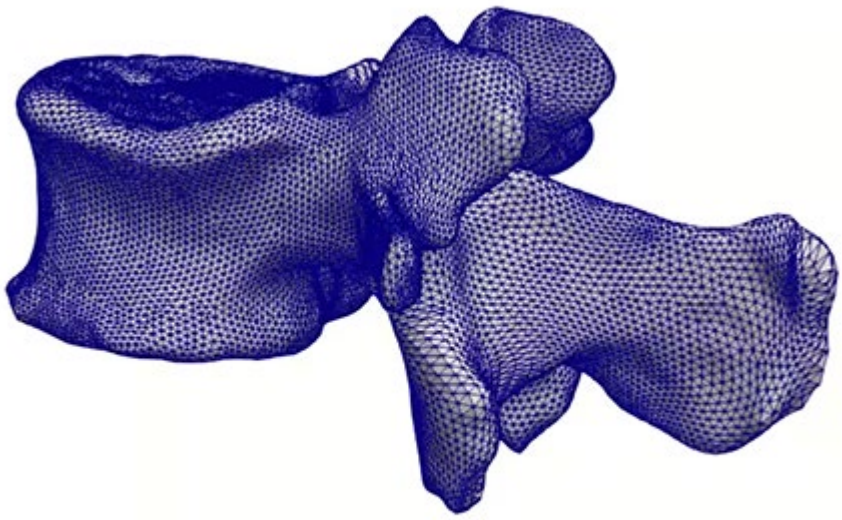
Hi Everyone, my name is Eve and I've recently joined Prof Sourbron's group as a PhD student in Medical

Imaging Physics at the University of Sheffield.

Previously I studied for an undergraduate Master's degree in Physics at the University of Glasgow, graduating in 2015. I have worked for the past 3 years undertaking my training as a Clinical Scientist at Sheffield Teaching Hospitals, specialising in Nuclear Medicine and Diagnostic Radiology.

My research now focuses on the development of spinal cord imaging in PET/MRI. Combined PET/MR of the spinal cord not only allows for dual acquisition of not only functional PET and structural MR data, but also presents the opportunity to include advanced MR techniques. This has potential applications in understanding the progression of neurodegenerative diseases such as Multiple Sclerosis, and examining potential treatment targets. However, imaging of the spinal cord is not without is challenges. One specific area to address is how we correct for the attenuation of radiation from PET tracers by the spine using information that can be acquired with MRI. Using a combination of physical phantoms and simulated acquisitions I will be exploring methods to improve the attenuation correction of PET data in PET/MRI of the spine and spinal cord.

Spinner fellows' mid-term presentations



Top Left Morphing Vertebra from Slide 11

SPINNER EID is a Doctorol Training Programme funded by the European Union's Horizon 2020 researh and innovation programme under the Marie Skłodowska-Curie Actions (MSCA) Innovative Training Networks (ITN) and European Industrial Doctorate (EID)

The programme, which is coordinated by Professor Gwen Reilly, has six bioengineering early stage researchers appointed as SPINNER fellows who are being trained to design the next generation of repair materials and techniques for spine surgery. The fellows have recently published their mid-term presentations which are available to view on the SPINNER website (links are located in the profile for each fellow).

Read more

Dr Arkadiusz Sitek joins Sano as Director

We are pleased to announce the nomination of Dr Arkadiusz Sitek as Director of the Sano Centre for Computational Medicine in Krakow, from the 17th February 2021.

He will also serve as the President of the Management Board and lead the Healthcare Informatics research group. Dr Sitek is a physicist and comes to Sano from IBM Watson Health in Cambridge, Massachusetts, USA.

Read more

Association of Biomedical Engineers, Medical Engineers and Bioengineers Membership

BioMedEng

The Association of Biomedical Engineers, Medical Engineers and Bioengineers (BioMedEng Association) is a not-for-profit organisation that advances education and knowledge transfer in Biomedical Engineering, Medical Engineering and Bioengineering. Under a variety of similar names, the organisation has held the annual UK bioengineering conference for over ten (10) years. These meetings have grown to become the UK's largest gathering of Biomedical Engineers, Medical Engineers and Bioengineers.

We are pleased to announce that the BioMedEng Association Membership System is now live and open to apply for membership.

As you know, Insigneo and the University of Sheffield will be the hosts of the BioMedEng21 conference this September and many Insigneo members will be involved as programme committee members, chairs and speakers. Regardless of whether the conference is in-person, hybrid or online BioMedEng Association members will be entitled to a registration discount for the Sheffield meeting.

Join BioMedEng Association

The University Of Sheffield.

BioMedEng21
The UK's largest gathering of Biomedical Engineers, Medical Engineers and Bioengineers

Abstracts open 26 February 2021

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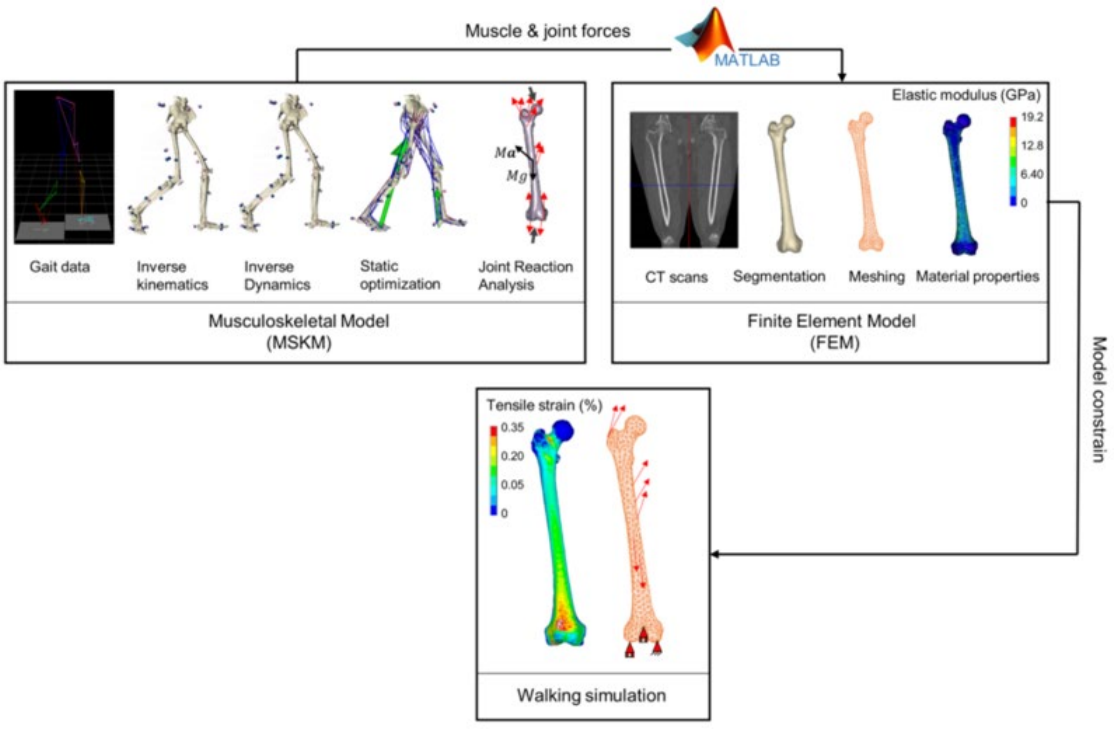
Visit BioMedEng21 conference website

Femoral neck strain prediction during level walking using a combined musculoskeletal and finite element model approach



Coupled musculoskeletal-finite element modelling approaches have emerged in recent years as a novel way to investigate femoral neck loading during various daily activities. Combining personalised gait data with finite element models will not only allow us to study changes in motion/movement, but also their effects on critical internal structures, such as the femur.

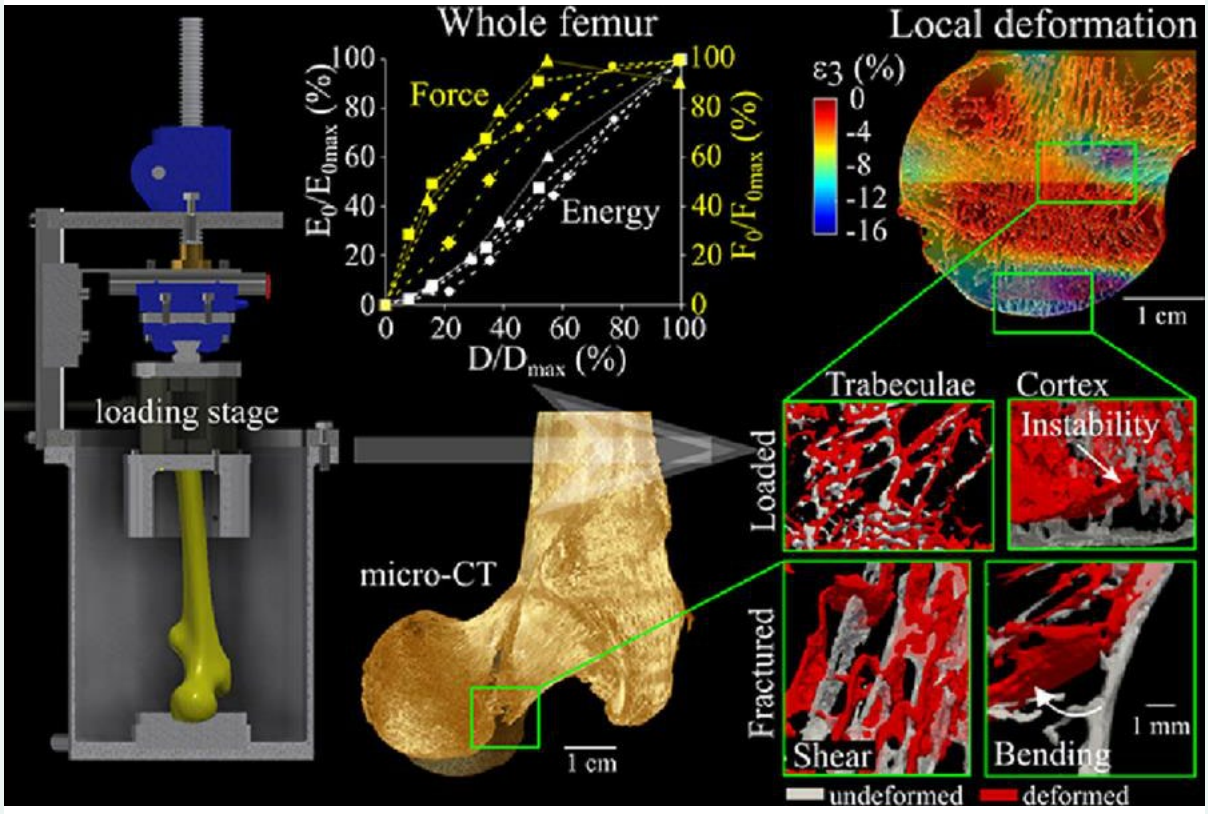
This study from our MultiSim researchers, for the first time, proposed a pipeline for a

fully personalised multiscale (body-organ level) model to investigate the strain levels at the femoral neck during a normal gait walking cycle. Muscle forces derived from the body level musculoskeletal models were used as boundary constraints on the finite element femur models.

The results suggested that personal variation among individuals is substantial in terms of the amount of loads induced in the femoral neck during normal walking. However, the highest femoral neck loads occur at the toe-off and/or heel strike phases of the gait cycle. The model can be extended to be used for various applications, such as orthopaedics, where this modelling approach could help planning treatment for hip and knee replacement.

Read more

Damage tolerance and toughness of elderly human femora

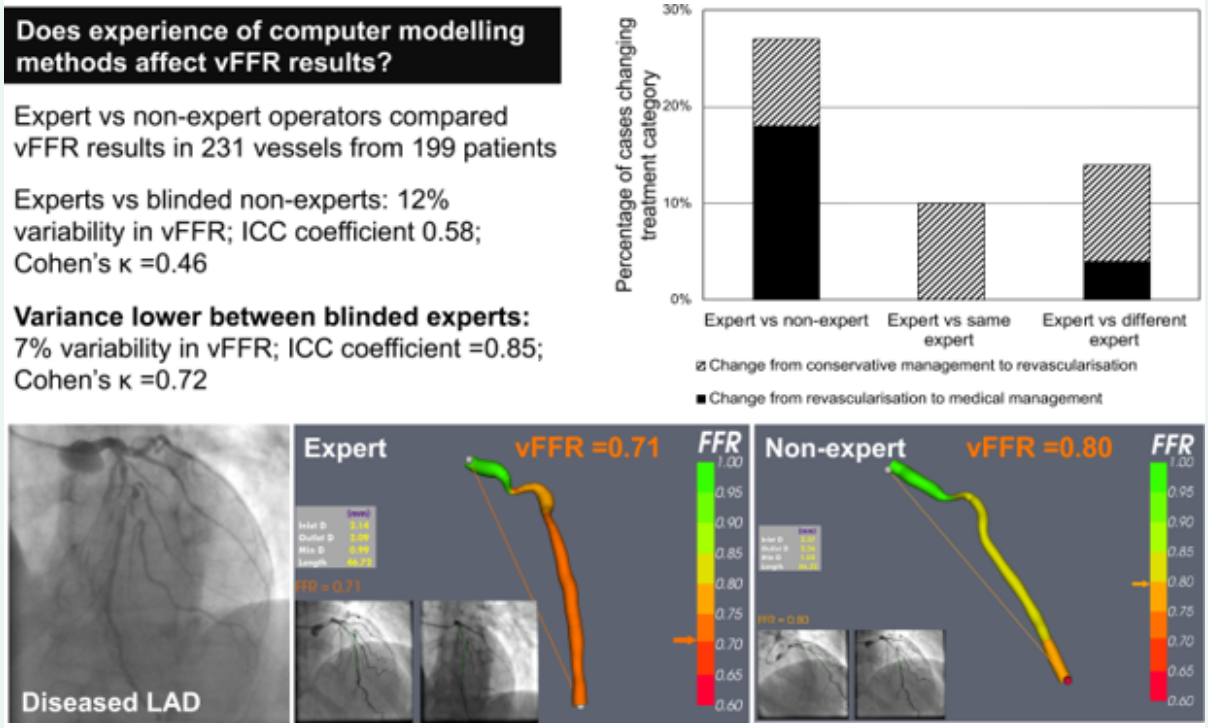


MultiSim researchers, in collaboration with colleagues at Flinders University (Adelaide, Australia), have published a paper in *Acta Biomaterialia* which analysed the mechanism of femoral fractures using the Bone Digital Volume Correlation algorithm developed at the University of Sheffield (BoneDVC, https://bonedvc.insigneo.org/dvc/).

The findings of this study will inform the advancement of current technologies for the prediction of fractures and interventions to reduce the burden of hip fragility.

Read more

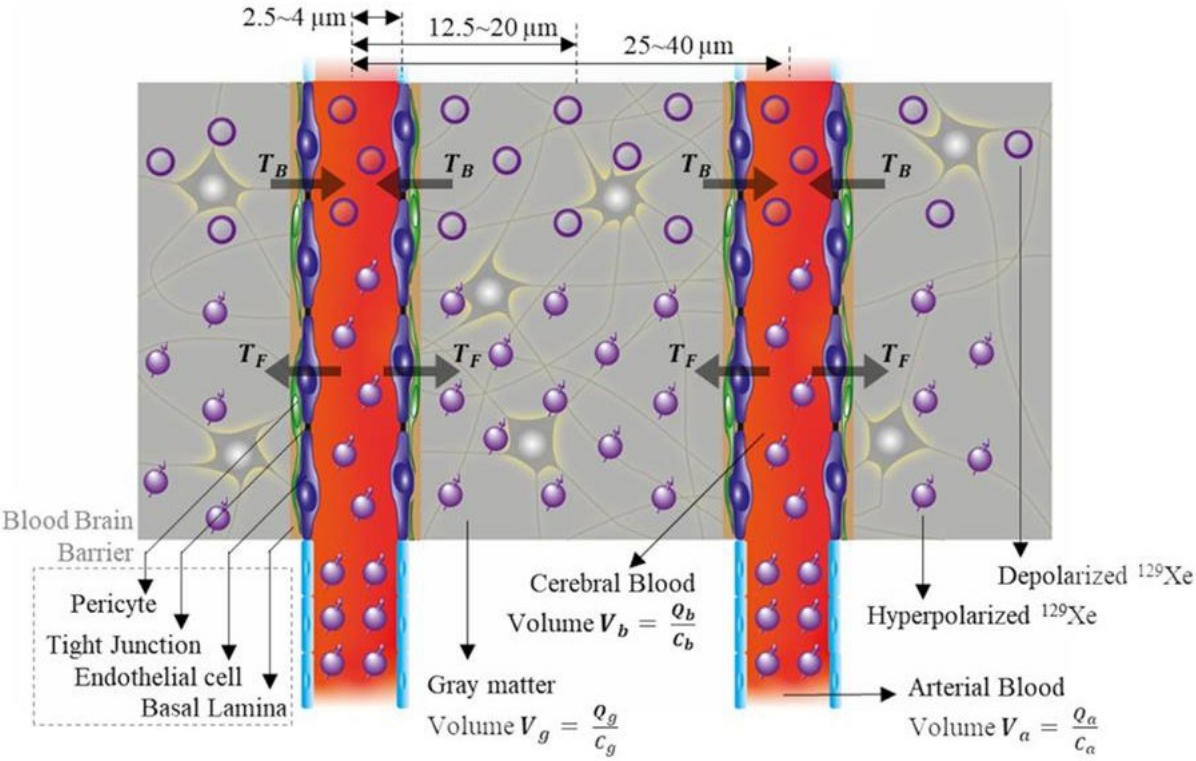
Operator-Dependent Variability of Angiography-Derived Fractional Flow Reserve and the Implications for Treatment



Researchers at the University of Sheffield's Department for Infection, Immunity & Cardiovascular Disease have published a paper in the journal *European Heart Journal - Digital Health* which shows that vFFR results are influenced by operator experience of vFFR processing. This had implications for treatment allocation. These results highlight the importance of training and quality assurance to ensure reliable, repeatable vFFR results.

Read more

Measuring 129Xe transfer across the blood□brain barrier using MR spectroscopy



In this study, Madhwesha Rao and colleagues from the Polaris research group at the University of Sheffield's Department for Infection, Immunity & Cardiovascular Disease developed a tracer kinetic model for time□resolved NMR spectra of HP 129Xe in the human brain to estimate the transfer rate of HP 129Xe from cerebral blood to gray matter that depends on a tracer transfer constant for a known mean transit time and cerebral blood volume for gray matter.

They believe this model will enable further studies to determine regional 129Xe tracer transfer constants with a focus of gaining insight into the pathophysiology of the blood brain barrier.

In addition, in light of the passive nature of the xenon tracer, it could serve as a cross□reference for studies involving oxygen, water or glucose uptake, which are driven by metabolism and/or electrolytic balance.

Read more

Guest Lectures, Conferences & Seminars

Insigneo Seminar: Base-pair resolution analysis of the effect of supercoiling on DNA structure and flexibility

Dr Alice Pyne
The University of Sheffield
19 February 2021

We are pleased to announce that Dr Alice Pyne from the University of Sheffield's Department of Materials Science and Engineering will give an online seminar on 'Base-pair resolution analysis of the effect of supercoiling on DNA structure and flexibility' on 19 February 2021.

Read more

Other Events

12 February
Oncology & Metabolism Seminar: Combatting the side effects of steroids - Professor Jeremy Tomlinson, University of Oxford - Insigneo members contact sarah.black@sheffield.ac.uk to arrange access.

12 February
IICD Department Research in Progress Meeting (Immunity Theme): Rob Byers, 'Skin Pathology assessment with Optical Technologies - The SPOT study' - Insigneo members contact sarah.black@sheffield.ac.uk to arrange access.

12-16 February
Orthopaedic Research Society, ORS 2021

15th February
Sano Seminar: Olav Zimmermann – Forschungszentrum Juelich GMBH

18 February
RSE course: Deep Learning with Tensorflow through Keras in R

22 February
Sano Seminar: Akadiusz Sitek - Presentation of the Sano research agenda, part 1.

24 February
VPHi Webinar: Translational Cardiovascular Modeling: Tetralogy of Fallor &

Modeling of Diseases

24 February
IICD Seminar: Consolidating Airway/Lung Atlases to better understand respiratory pathologies, Dr Pascal Barbry, Université Côte d'Azur - Insigneo members contact sarah.black@sheffield.ac.uk to arrange access.

26 February
Oncology & Metabolism Seminar: Cancer theme (title TBC) Agnieszka Gambus, University of Birmingham - Insigneo members contact sarah.black@sheffield.ac.uk to arrange access.

01 March
Sano Seminar: Akadiusz Sitek - Presentation of the Sano research agenda, part 2.

15 - 20 May
ISMRM & SMRT Annual Meeting & Exhibition

7 -11 June
5th VPH Barcelona Summer School: Tackling Complexity in Health & Medicine

11 -14 July
ESBiomech Conference 2021, Milan

25 - 29 July
ISB2021, Stockholm

6 - 7 September
BioMedEng21, Sheffield

15 September
CompBioMed Conference 2021: Building the Virtual Human

For a full list of upcoming events visit: http://insigneo.org/events/

Publications

Research output affiliated to Insigneo in Scopus (please ensure papers are affiliated to the Insigneo Institute by including the words "Insigneo Institute for *in silico* Medicine"):

Analysis of mechanotransduction dynamics during combined mechanical stimulation and modulation of the extracellular-regulated kinase cascade uncovers hidden information within the signalling noise: Computational

Biomedicine (Interface Focus) G. Ascolani, T. M. Skerry, D. Lacroix, E. Dall'Ara, A. Shuaib

Evaluation of patient tissue selection methods for deriving equivalent density calibration for femoral bone quantitative CT analyses (Bone) C. Winsor, X. Li, M. Qasim, C. R. Henak, P. J. Pickhardt, H. Ploeg, M. Viceconti

Identifying and mapping chemical bonding within phenolic resin using secondary electron hyperspectral imaging (Polymer Chemistry) N.T. H. Farr, S. F. Hamad, E. Gray, C. M. Magazzeni, F. Longman, D. E. J. Armstrong, J. P. Foreman, F. Claeyssens, N. H. Green, C.Rodenburg

Measuring 129Xe transfer across the blood-brain barrier using MR spectroscopy (Magnetic Resonance in Medicine) M. R. Rao G. Norquay N. J. Stewart J. M. Wild

Understanding Surface Modifications Induced via Argon Plasma Treatment through Secondary Electron Hyperspectral Imaging (Advanced Science) N. Farr, J. Thanarak, J. Schäfer A. Quade, F. Claeyssens, N. Green, C. Rodenburg

Maximal Exercise Testing Using the Incremental Shuttle Walking Test Can Be Used to Risk-Stratify Patients with Pulmonary Arterial Hypertension (Annals of the American Thoracic Society) R. A. Lewis, C. G. Billings, J. A. Hurdman, I. A. Smith, M. Austin, I. J. Armstrong, J. Middleton, A. M. K. Rothman, J. Harrington, N. Hamilton, A. G. Hameed, A. A. R. Thompson, A. Charalampopoulos, C. A. Elliot, A. Lawrie, I.Sabroe, J. M. Wild, A. J. Swift, R. Condliffe, D. G. Kiely

Optimization of the failure criterion in micro-Finite Element models of the mouse tibia for the non-invasive prediction of its failure load in preclinical applications (Journal of the Mechanical Behavior of Biomedical Materials) S. Oliviero, R.Owen, G. C.Reilly, I. Bellantuono, E. Dall'Ara

Damage tolerance and toughness of elderly human femora (Acta Biomaterialia) S. Martelli, M. Giorgi, E. Dall' Ara, E.Perilli

Endothelial function in cardiovascular medicine: a consensus paper of the European Society of Cardiology Working Groups on Atherosclerosis and Vascular Biology, Aorta and Peripheral Vascular Diseases, Coronary Pathophysiology and Microcirculation, and Thrombosis (Cardiovascular research) Y. Alexander, E. Osto, A. Schmidt-Trucksäss, M. Shechter, D. Trifunovic, D. J. Duncker, V. Aboyans, M. Bäck, L. Badimon, F. Cosentino, M. De Carlo, M. Dorobantu, D. G Harrison, T. J. Guzik, I. Hoefer, P. D. Morris, G. D. Norata, R. Suades, S. Taddei, G. Vilahur, J. Waltenberger, C. Weber, F. Wilkinson, M.-L. Bochaton-Piallat, P. C. Evans

The Application of Digital Volume Correlation (DVC) to Evaluate Strain

Predictions Generated by Finite Element Models of the Osteoarthritic Humeral Head (Annals of Biomedical Engineering) J. Kusins, N. Knowles, M. Columbus, S.Oliviero, E. Dall'Ara, G. S. Athwal, L. M. Ferreira

Femoral neck strain prediction during level walking using a combined musculoskeletal and finite element model approach (PLoS ONE) Z. Altai, E. Montefiori, B. van Veen , M.A. Paggiosi, E. V. McCloskey, M. Viceconti, C. Mazzà, Xi. Li

Non-invasive prediction of the mouse tibia mechanical properties from microCT images: comparison between different finite element models (Biomechanics and Modeling in Mechanobiology) S. Oliviero, M. Roberts, R. Owen, G. C. Reilly, I. Bellantuono, E. Dall'Ara

Revealing the nanoindentation response of a single cell using a 3D structural finite element model (Journal of Materials Research) W. Yang, D. Lacroix, L. P. Tan, J. Chen

Operator-Dependent Variability of Angiography-Derived Fractional Flow Reserve and the Implications for Treatment (European Heart Journal - Digital Health) K. Lal, R. Gosling, M. Ghobrial, G. J Williams, V. Rammohan, D. R. Hose, P. V. Lawford, A. Narracott, J. Fenner, J. P. Gunn, P. D. Morris

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