# Graphene sensors for Alzheimer's biomarker detection

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# INSPIRE Interdisciplinary Meeting Programme

Saturday 6th April, Sherwell Centre, University of Plymouth

9.45-10.10: Registration and coffee

Opening comments

10.10-10.20: Dr Alan Millard

**Title: Medical Applications of Swarm Robotics**

Abstract: Swarm robotics is an emerging technology inspired by natural systems that examines how agents following simple rules can produce sophisticated collective behaviours. Through interactions between individual agents and their environment, robot swarms are able to aggregate, coordinate their motion, and cooperatively transport objects. This talk will outline how concepts developed in swarm robotics research are potentially transferrable to medical applications, through the coordination of nanoparticles, programmable biological cells, and chemical compounds, for tasks such as targeted drug delivery or cancer treatment.

10.20-10.55: Mr Henry Sells (University Hospitals Plymouth)

**Title: Robots in Surgery**

10.55-11.25: Professor Angelo Cangelosi

**Title: Developmental Robotics: From Babies to Robots**

Abstract: This talk will introduce the field of developmental robotics. This consists on the design of intelligent behaviour and cognitive capabilities in robots, by taking direct inspiration from developmental psychology and from cognitive neuroscience. It will describe a set of robotics studies and neuro-cognitive architectures where experiments with baby robots replicate known child psychology phenomena on embodied language learning. The talk will also show how deep learning methods can be used in cognitive robotics research, and will briefly present examples of application of robotics in health and social care.

UNIVERSITY OF PLYMOUTH INSPIRE The Academy of Medical Sciences

11.25-11.55: Dr Joel Tabak (University of Exeter)

**Title: How Ion Channels Shape Electrical Activity in Endocrine Cells**

Abstract: Cells of different types generate electrical activity, and rely on this electrical activity to function and communicate with other cells. In endocrine cells, electrical activity controls hormone release, according to messages received from other organs. We study electrical activity using a combination of electrical recordings from individual cells, and mathematical models of electrical currents across cell membranes. This multidisciplinary approach culminates in a hybrid technique called dynamic clamp, which is unique to the study of electrical activity in single cells.

11.55-12.25: Dr Alex Besinis (University of Plymouth)

**Title: Engineered Nanomaterials in Medicine and Dentistry: Benefits and Potential Risks**

Abstract: Interest in the use of engineered nanomaterials (ENMs) in medicine and dentistry is growing with ENMs finding many clinical applications in infection control strategies, drug delivery, medical imaging, nanocomposites, biomaterials and medical implants. However, ENMs have unique properties compared to their bulk counterparts and in many cases unpredictable interactions with bacteria, human cells and tissues. Nanomaterials are novel materials that may also pose novel health risks. The factors affecting the biological behaviour and toxicity of nanomaterials will be discussed providing specific examples from the published literature. Ways to benefit from nanotechnology while avoiding health hazards will be also addressed.

12.25-12.35: Previews of Lunch Demonstrations

12.35-14.00: Lunch/ Posters / Demos

14.00-14.50: Professor Ian Craddock (University of Bristol)

**Title: A Digital Future for Health?**

Abstract: Digital technologies have transformed the way we shop, hail a taxi, plan our holidays, learn and interact with our friends. There is very broad consensus that they will - and indeed that they must - transform healthcare over the coming decades.

Professor Ian Craddock is Director of the new Centre for Doctoral Training for Digital Health in Bristol and will be talking about some of those anticipated transformations, the promise that they hold and the pitfalls along the way. There will also be an opportunity to reflect and discuss how this might change the training, roles and careers of health professionals in the coming years.

14.50-15.20: Dr Shakil Awan (University of Plymouth)

**Title: Graphene sensors for Alzheimer's biomarker detection**

Abstract: The talk will briefly describe what is graphene and related 2-dimensional materials and how they can be applied to a variety of applications, including biosensors. We have recently detected Clusterin protein which is widely considered to be a key biomarker of Alzheimer's disease (AD). AD currently affects ~30 million people worldwide and costs the global healthcare system ~$1T and with aging populations around the world these figures are expected to increase significantly over the next 20 years. The talk will also highlight the challenges of exploiting graphene and 2D materials for biosensing and the future directions of this research.

15.20-15.30: Tea and Coffee Break

15.30-16.00: Dr Elsa Fouragnan (University of Plymouth)

**Title: Neuromodulation of Cortical Networks Underlying Decision-making with Transcranial Focused Ultrasound**

Abstract: Most psychiatric disorders are treated by either the prescription of drugs that cause alterations in brain function or cognitive behavioural therapy (CBT) that attempt to induce behavioural changes in response to challenging situations. However, long-term treatment of CBT is often not very effective, and drugs can present many side effects. An exciting alternative to drugs and surgery is brain neuromodulation using ultrasound. Ultrasound is widely known as a safe diagnostic imaging tool, particularly during pregnancy. In recent years, a growing number of therapeutic applications of ultrasound have also been presented and validated, including the modulation of brain activity. This is possible because the mechanical vibrations caused by ultrasonic waves can generate internal forces that act on the brain cells. In this talk, I will show how transcranial focused ultrasound allow us to achieve non-invasive and reversible deep brain neuromodulation with high precision in non-human primates and what are the behavioural consequences of such neurostimulation on decision making.

16.00-16.30: Dr Cito Maramba (University of Plymouth)

**Title: User Experience (UX) Evaluation of Digital Health Technologies**

Abstract: One of the objectives of the NHS Long Term Plan is for digitally enabled care to go mainstream across the NHS. This means that new digital health technologies are going to be developed and adopted into care pathways. User Experience (UX) evaluation is important to ensure that these newly developed technologies are usable, useful and safe. We will discuss the results of a scoping review of usability testing in the development of digital health technologies, as well as the plan for a programme of research for capability and capacity building in UX evaluation in a regional digital health ecosystem.

16.30-17.00: Dr Yinghui Wei (University of Plymouth)

**Title: Statistical Applications in Medical Sciences**

Abstract: Statistics plays an important role in medical research. The use of statistics allows clinical researchers to optimise the study design, control for confounding factors and minimise biases, make treatment comparisons, outcome prediction and disease classification. I will illustrate example applications of statistics in the design and analysis of clinical studies.