IT Services

Case Study

BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

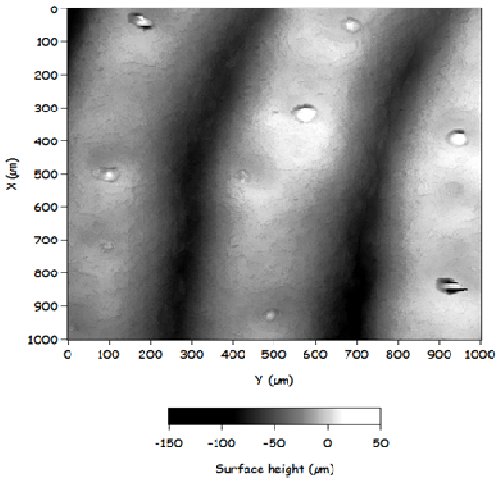
NanoBioTouch:
Nano-resolved multi-scale investigations of human tactile sensations and tissue engineered nanobiosensors

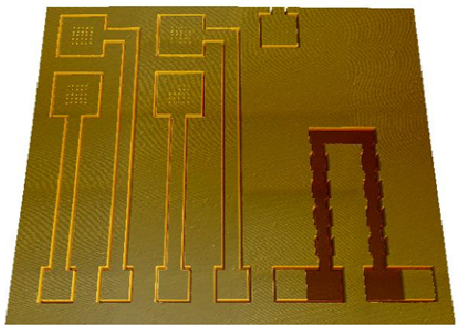
Challenges & Background

The overarching aim of NanoBioTouch is to radically improve understanding of the human mechanotransduction system and tissue engineered nanobiosensors. The mechanotransduction system controls how an organism's interaction with the environment is perceived in terms of the tactile sensations it receives. These tactile sensations, or touch, can be considered a complex multi-scale interaction of biophysical and biochemical phenomena that transduce mechanical stimuli imposed by shape, texture, stiffness, temperature and movement of surrounding objects. The investigation of this interaction will be achieved through the systematic integration of new developments in new scientific areas by involving academic and industrial experts who are experts in cognitive sciences, microneurography, brain imaging, cell biology and mechanics, tissue engineering, skin physics, microengineering, multi-scale multi-physics modelling, information processing, robotics, prosthetics and medical rehabilitation.

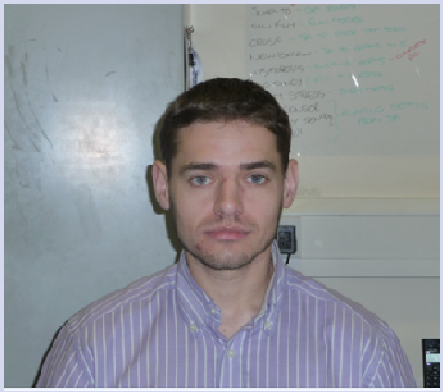
One aspect of this project is the development of a novel micro electro-mechanical sensor array capable of measuring forces and local temperature fluctuation during tactile contact. This will help to quantify the parameters of affective touch, defined here as the assessment of the pleasantness and preference of a particular tactile experience. Many industrial sectors will benefit from understanding and optimising the tactile perception of their products in order to achieve better consumer satisfaction. Furthermore, an understanding of mechano-transducting sub-systems can inspire many biomimetic engineering solutions related to sensor technologies, smart material composites and micro-tribological systems in addition to information processing.

While the initial phase of the project seeks to develop a multiplexed sensor array using already existing technology, the remainder of the project will push current sensor technologies way beyond the state-of-the-art by developing a bio-hybrid chip that will interface new sensing technologies with cell-types found in skin. However, in order to ensure the response of the multiplexed sensor array is comparable to the bio-hybrid chip, and indeed to human skin, it is necessary to model how the sensor array responds to certain stimuli. This process is complicated by the texture and transient viscoelastic properties of skin which need to be emulated by the coating of the sensor array. The BlueBEAR cluster with its high-class computational facilities along with the powerful Abaqus finite element software means that all these geometric and material non-linearities can be coupled with the physics of the sensor to create a complete and accurate model of the system.





Interferometric image of section of the sensor array including four capacitive force transducers and a temperature sensor



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Product Used
Abaqus

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