

“Computational Science Meets Medicine: Clinical Applications in Neurological and Vascular Diseases”

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Mathematical modelling and computer simulation have proved tremendously successful in engineering. One of the greatest challenges for mechanists is to extend the success of computational mechanics to fields outside traditional engineering, in particular to biology, biomedical sciences and medicine. By extending the surgeon’s ability to plan and carry out surgical interventions more accurately and with less trauma, Computer-Integrated Surgery (CIS) systems could help to improve clinical outcomes and the efficiency of health care delivery. CIS systems could have a similar impact on surgery to that long since realized in Computer-Integrated Manufacturing (CIM).

In this lecture I will demonstrate how computational mechanics can be used to improve patient outcomes in brain and vascular surgery. I will showcase three successful applications, one about using computational models as an aid for neuronavigation in brain tumour removal procedures; second about neuronavigation in epilepsy surgery, and the third about abdominal aortic aneurysm (AAA) disease progression and rupture risk prediction.

I will conclude with suggestions for the future developments in the field and a vision for a new era of personalised medicine based on patient-specific scientific computations.