world we live in

Imaging all the people: digital imaging at Kingston is pushing the boundaries of conventional wisdom.

The growing world of digital imaging enables computers to capture, store and process digital images from cameras, medical scanners and remote-sensing satellites. Kingston's Faculty of Computing, Information Systems and Mathematics is at the forefront of innovative research in the uses of computer imaging for everything from detecting cancer to preventing gun crime.

Dr Jean-Christophe (JC) Nebel is working on a government-funded project to help train computers to recognise people carrying guns from CCTV footage. This work builds on the technology developed at the Digital Imaging Research Centre for the analysis of the trajectories of people monitored by CCTV, to detect unusual and possibly dangerous behaviour.

"Following the London bombings, the police examined CCTV videos to identify the bombers," he said. "One thing that emerged was that the people carrying the bombs were walking in a distinctive way, different from other passengers who appeared on the videos: like men on a mission."

Similarly, says JC, people carrying guns behave in a distinctive way. "You carry a gun only if you think you're going to use it – the penalty for being caught is too high for people to carry one casually. It's a bit like people's behaviour when they get a new phone: at first they're checking up on it constantly. After a few weeks they will be much less anxious. So somebody with a gun will be in an altered psychological state: scared, or over-excited. We want to understand and map how this affects their physical behaviour."

"Humans can recognise walks," JC says, pointing to animated 3D figures on his PC screen. "That one's drunk, that one's threatening. The challenge is, can we train computers to recognise these behaviours?"

Along the corridor, Dr Andreas Hoppe in collaboration with Cancer Research UK, is developing image processing methods to assess sarcoma cells – the cells which cause cancer metastases (secondaries).

"We wanted to understand how sarcoma cells adhere to endothelial
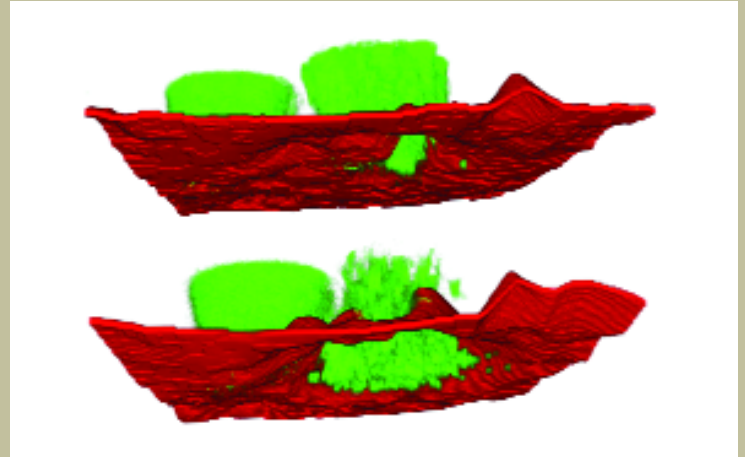
**Sarcoma cells can invade human tissue in just two hours**

cells, which line blood vessels, and migrate into the tissue to form tumours. We wanted to develop the imaging technology so that we could see this invasion, measure it and quantify it and then study the mechanisms of the invasion process".

To observe how sarcoma cells behaved, a flow chamber was developed which could simulate the blood flow over endothelial cells. Sarcoma cells were pumped through the chamber and computerised microscopy, in conjunction with novel image processing techniques, enabled the observation of sarcoma cells invading the endothelial cells. "Currently, you can't get high resolution images of these dynamic processes taking place in the

human body, so we used this model approach instead. It's a very sophisticated imaging process, and images are cleaned up and reconstructed for quantitative analysis."

Andreas and collaborators discovered that the pressure of flow appears to modulate the invasion of sarcoma cells, and also discovered that the process of invasion is shockingly fast – a sarcoma cell can invade in two hours or less. "Next, we'd like to find out more about the functional mechanisms which prompt the invasion, and to do it on a much larger scale: we were using a small number of cells. Eventually, the aim is to use our understanding of these invasion mechanisms, so that we can learn to switch them off."

**Best foot forward: analysing walking patterns**
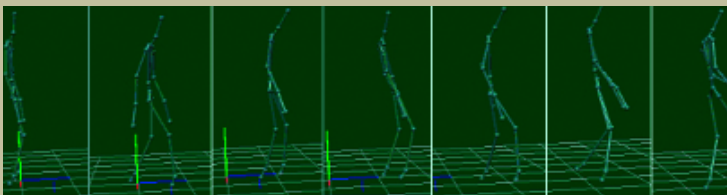
The eyes have it

Software specialists from Kingston's Digital Imaging Research Centre and healthcare experts from St George's, University of London are conducting a study of children's retinas, exploring their veins and possible links to major illnesses later in life.

The study of 750 10 year olds will compare retinal blood vessels in British-born children from South Asian, Afro-Caribbean and white European backgrounds. Britons of South Asian heritage are more likely to suffer from type 2 diabetes and

coronary heart disease than their white European peers, while those of Afro-Caribbean origin tend to be more susceptible to type 2 diabetes and strokes in adulthood. Dr Christopher Owen of St George's explains:

"Our aim is to gain greater understanding of the development of vascular disease by determining exactly when doctors might expect to see the earliest warning signs of such illnesses, particularly in ethnic groups where there is a high risk factor. Research could also have another significant spin-off, helping to stem the occurrence of sight-

Don't blink: mapping the eye's capillaries
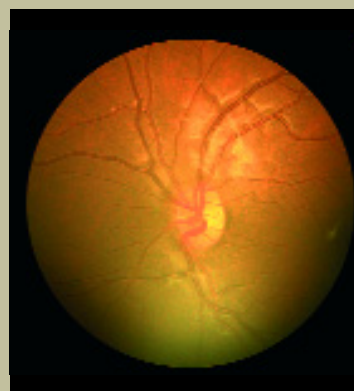
threatening diseases such as glaucoma in adulthood."

Senior Kingston lecturer Dr Sarah Barman says the non-invasive nature of the study posed challenges when photographing children's eyeballs. "Ethical constraints mean we can't use eye drops to dilate their pupils as we would generally do when working with adults. This affects the sharpness and lighting of the images. We need to adapt our technology to pick up even the faintest outline of an artery with pinpoint accuracy," she says.