STEM RESEARCH HIGHLIGHTS

Imaging & analysis examples

Several imaging techniques are in development that could potentially provide new in vivo diagnostic tools for cancer detection. In addition, existing imaging approaches for therapy monitoring are being combined with advanced image analysis to reduce damage to healthy tissue during radiotherapy. Novel methods could enable in situ 'biopsies' for characterising tissue without excision.

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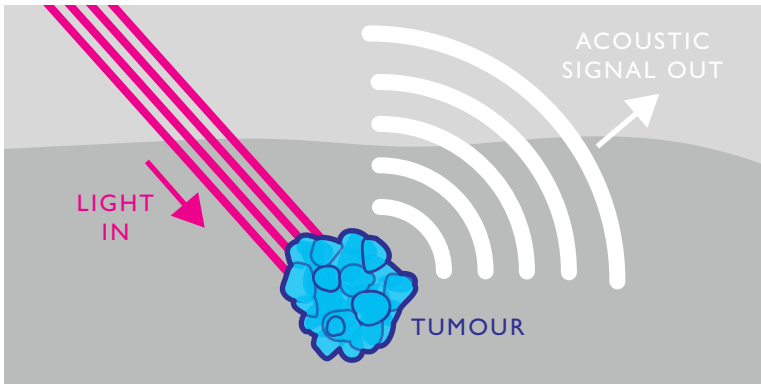
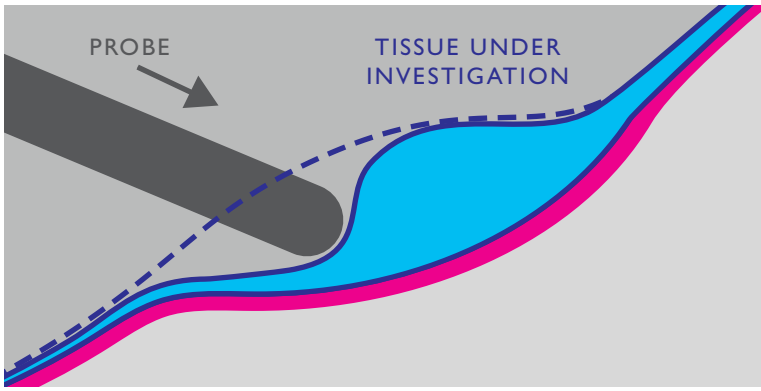
Optical macroscopy

Capability - Measures tissue functional and molecular parameters at up to 150µm resolution and up to 4cm depth.
Clinical potential - Maps tissue blood content and oxygenation as well as melanin, water and fat content. Can enable assessment of tumour oxygenation and stromal content in vivo. Contrast agents can target molecular processes in cells, such as cell death.
Technology - Optoacoustics – transmit optics, receive acoustics.
Applications - In vivo tumour monitoring.
Relevance for cancer - Currently being investigated for assessing vascular function in pre-clinical models of prostate and breast cancer. Human clinical trials in breast cancer have commenced.



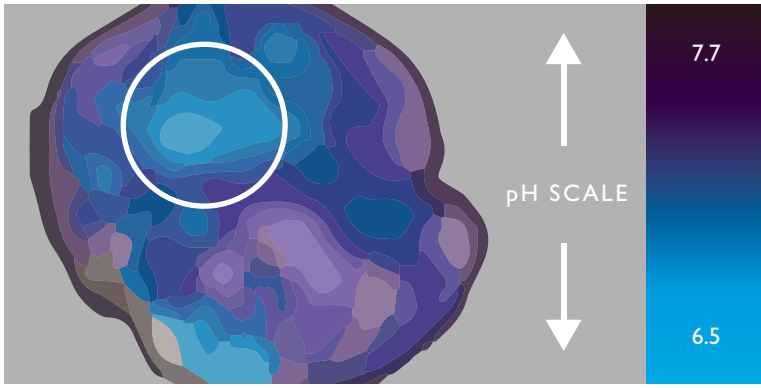
Mechanical biopsy

Capability - Monitors material response to deformation and detects changes in mechanical properties of a sample in situ.
Clinical potential - Quantitative palpation of tissue to determine how it 'feels' and responds to mechanical stimulation. Cancer causes changes to tissue stiffness and elasticity and this could assist in minimally invasive procedures.
Technology - Tissue mechanics.
Applications - In situ biopsy.
Relevance for cancer - Could be implemented as a mechanical biopsy approach for use during endoscopy where suspicious tissue could be mechanically interrogated in situ and in real time.



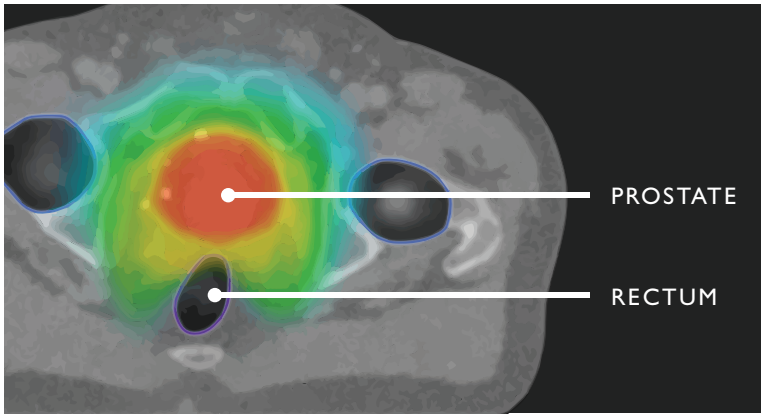
Hyperpolarised MRI

Capability - Uses magnetic resonance imaging to detect dynamic metabolic processes.
Clinical potential - Images metabolic parameters related with disease progression, e.g. cellular respiration, redox balance and pH.
Technology - Hyperpolarised magnetic resonance imaging (MRI) and spectroscopy (MRS).
Applications - In vivo tumour monitoring.
Relevance for cancer - Solid tumours exhibit a high level of anaerobic metabolism, enabling disease progression tracking. Could delineate aggressive from indolent disease. May be best paired with a low cost sensing test to stratify patients for imaging.



Dynamic modelling from imaging

Capability - Extracts information from a set of images, such as a contour of a complex body part, and uses biomechanical modelling to monitor how this moves in time.
Clinical potential - Can be applied in any dynamic imaging scenario, e.g. cardiac imaging, to characterise movement.
Technology - Feature extraction, co-registration, biomechanical modelling.
Applications - Dynamic imaging and modelling.
Relevance for cancer - Currently applied in the VoxTox project to extract rectum contours from CT scans and model movement to improve targeting of image-guided radiotherapy for prostate cancer. Could also be used to monitor changes in tumour size.



To discuss opportunities contact **EDadmin@hermes.cam.ac.uk**