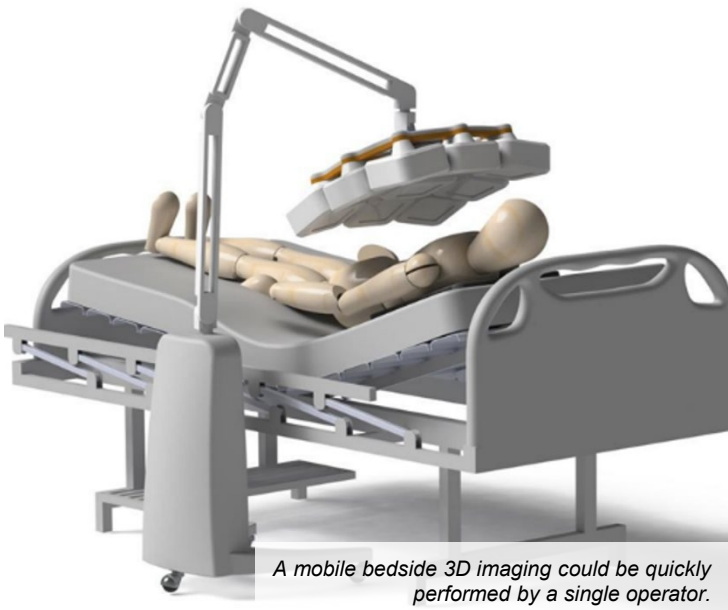
UNIVERSITY OF LIVERPOOL

QUASAR GROUP

CASE STUDY

Optimisation of cold-cathode flat panel X-ray source technology for use in a mobile, bedside, 3D chest imaging system



A mobile bedside 3D imaging could be quickly performed by a single operator.

Diagnostic imaging

Diagnostic imaging techniques help identify the cause of an injury or illness and ensure that the clinical diagnosis is accurate. These techniques include 2D and 3D X-rays, computed tomography (CT) scans, and magnetic resonance imaging (MRI).

2D X-ray is the most common type of medical imaging with more studies performed than MRI, CT and ultrasound combined. 2D X-ray imaging devices however, give a rather limited view of anatomy. In addition, 3D imaging devices with conventional X-ray tubes suffer from high input power, high radiation dose and large size. The necessary source movement makes them non-portable and expensive, limiting their availability in smaller clinics.

Novel low-dose alternative X-ray sources ("cold cathode" sources) have been developed that can overcome these problems by using arrays of individually controllable miniature X-ray emitters in a flat panel and the 3D imaging technique of digital tomosynthesis (DT). DT uses images from multiple angles to reconstruct a 3D volume and requires far fewer images within a smaller angular range than CT.

Towards a versatile chest 3D imaging system

The QUASAR Group at the University of Liverpool in collaboration with award-winning company Adaptix, built upon existing research to develop and commercialise a novel chest 3D DT system. Previously joint research focused on detailed simulation studies into dose modelling, specification tolerance and image formation.

In order to extend and strengthen the research collaboration with Adaptix, STFC Impact Acceleration Account funding was used to support a joint R&D project into the optimisation of the design of a novel chest 3D DT system, verifying simulations and literature predictions. This bedside system is expected to push the boundaries in bedside imaging systems and could potentially replace 2D X-ray imaging, offering more accurate localisation of diseases and minimising patient transfers in clinics.

Planned developments

Future joint R&D will focus on upgrading Adaptix's current cold-cathode flat panel X-ray source (FPS) technology to a higher voltage and higher current, finding the optimum panel and array configuration for the larger irradiation area required in chest imaging.

Monte Carlo (MC) simulations will be carried out, in parallel to experimental parameter scans with Adaptix's FPS and conventional sources. Beyond medical imaging, X-ray tubes have found many applications including archaeology, airport and cargo security, fine art and wild-life conservation. The availability of truly portable, low dose and low cost FPS technology and associated MC simulation framework has the potential to disrupt a large spectrum of applications for which X-ray tubes have been the workhorse for over a hundred years.

'The successful partnership between the QUASAR Group and Adaptix paves the way to bringing low-dose, mobile 3D imaging to the bedside of patients. This will significantly improve clinical care and provide significant cost savings with excellent prospects to disrupt the £9 billion X-ray imaging market!

- Professor Carsten P Welsch, QUASAR Group Leader

The Quantum Systems and advanced Accelerator Research (QUASAR) Group is an internationally structured research group. We are amongst the world-leaders in beam instrumentations development, beam dynamics studies for accelerators and light sources. If you would like to find out more about our work on next generation particle accelerator diagnostics, please get in touch.

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