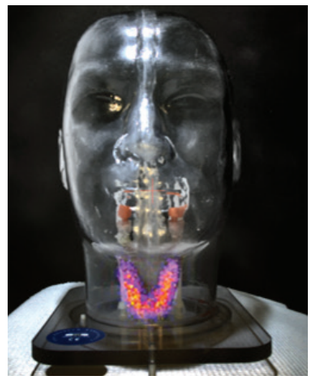
Seeing is believing

Mark Rosser on making the invisible visible: Gamma-Optical imaging technology

Mark Rosser

When clinicians need to precisely locate radioactive tracers in a patient's body, or nuclear decommissioning engineers must identify contamination hotspots, seeing the invisible becomes crucial. Our groundbreaking hand-held gamma video camera system now allows users to literally "see" radiation in real-time, superimposed on ordinary visual images. This revolutionary technology deployed in a hand-held gamma-optical camera "Seracam®" is finding applications across medical diagnostics, image guided surgery, and industrial radiation management—but its origins trace back to the stars.

Thyroid hybrid



Space Origins

The story begins not in a medical laboratory, but in space. X-ray astronomy telescopes like NASA's Chandra and ESA's Newton XMM require extraordinarily sensitive detection systems to capture faint signals from distant celestial bodies. These orbital platforms demand lightweight, compact detectors since Earth's atmosphere absorbs most x-rays from space. The original developers of Seracam®, Prof. John Lees (University of Leicester) and Prof. Alan Perkins (University of Nottingham) recognised that these same design principles—high sensitivity, precision, and compactness—could revolutionise nuclear medicine on Earth. They envisioned adapting space technology to create something previously unavailable: a hand-held gamma camera that could merge real time radiation images with optical imaging at the point of use.

The Innovation Breakthrough

This overlay allows users to see exactly where radiation sources are located within the visible environment, regardless of viewing angle or distance, with immediate feedback direct to the operator.

"It shows you exactly where the radiation is, what shape it is, and how many counts you're getting," explains Dr. Sarah Bugby from Loughborough University, who has been involved in expanding the technology's applications. "The feedback is in real time. With the overlaid optical and gamma video, you can track sources as you move them."

The technology's evolution by Serac Imaging Systems took two parallel paths: medical imaging applications and industrial nuclear deployment.

Medical Applications

Design consultancy TTP was engaged to transform the academic prototype into a market-ready medical device. Adding an optical camera to match the gamma camera's field of view while preserving a compact design was a key engineering challenge. The solution included:

- Custom optical camera design – Specifically developed to complement the gamma imaging system.
- Field of view, magnification, and optical axis matched to ensure alignment of the x-ray and optical images for any object distance and angle – Maintaining perfect alignment at any distance and angle.
- Optical and gamma-ray imaging along a common optical axis – ensuring the gamma and optical images remain co-registered without distortion.

Redesign work required to transform the prototype into a compact, fully functional, user-friendly imaging device, required:

- Fully integrated electronics – All components housed within the camera head for portability.
- Sophisticated data processing algorithms – Enabling low-power operation while maintaining real-time imaging performance.
- Live-streamed dual-modality imaging – A single cable provides both power and data, simplifying setup and use.

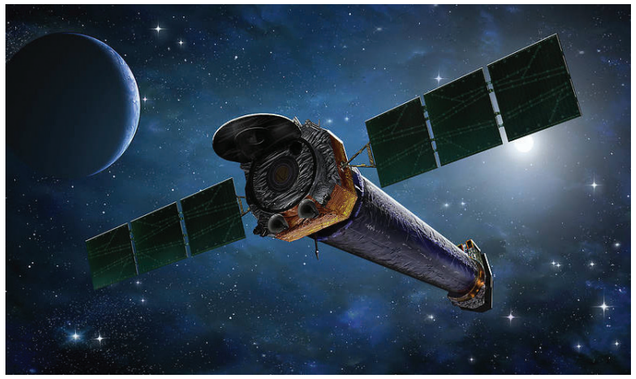
An easy-to-use graphical user interface (GUI) was a key part of the design process enabling:

- Seamless camera control – Adjustments for imaging settings and real-time visualisation
- Image capture, storage, and transmission – Direct integration with hospital PACS (Picture Archiving and Communication System).
- Rapid deployment in any hospital setting – Enabling imaging at the point of use without requiring a dedicated suite.

Clinically, the resulting Seracam® system is now in beta testing with over 150 patients imaged. Optimisation of the system for medical use has continued supported by a grant from Innovate UK, the UK's innovation agency, to Loughborough University to co-fund the development of the camera for image guided surgery.

Industrial Nuclear Applications

Simultaneously, Dr. Bugby pursued industrial applications at Loughborough University, focusing on nuclear decommissioning challenges. Supported by Sellafield Ltd.'s "Game Changers" program, she demonstrated how the technology could revolutionise post-operational clean-out of radioactive facilities: immediate visual feedback on radiation locations, allowing tracking of contamination movement, establishing clear endpoints for decontamination efforts, and reducing worker exposure through more efficient operations.



NASA's Chandra

Image credit: NASA/CXC & J.Vaughan

Convergent Design Benefits

Though developed for different sectors, the technology's design requirements converged. Features beneficial across both domains include: intuitive operation requiring minimal specialised training, sealed and easily cleanable surfaces preventing contamination, stand-alone operation with built-in cybersecurity, and compliance with stringent safety regulations.

Expanding Applications

The Seracam® platform technology brings the performance and speed designed for surgical precision to the nuclear industry, with the compact size and versatile design enabling multiple deployment configurations. These include hands-free or hand-held operation for direct manipulation and scanning by operators; robotic integration with mechanical arms for remote operation; drone and vehicle mounting for accessing difficult areas; and submersible deployment with waterproof versions for underwater applications. In future, Serac Imaging Systems plan to introduce AI-enhanced analysis using machine learning algorithms for automated feature recognition and 'hot spot' identification.

Cross Disciplinary Innovation Impact

By adapting principles developed for space exploration, our engineering team has created a versatile tool with wide-ranging benefits. For medicine, it offers enhanced diagnostic precision and surgical guidance. For the nuclear industry, it enables safer, more efficient decommissioning and waste management. For both fields, it provides unprecedented visualisation of invisible radiation sources.

From stars to surgical suites to nuclear facilities, the fusion of gamma detection and optical imaging, resulting in the ability to "see" radiation, is creating new possibilities in both medical and nuclear industry spheres.

Bench set up

Mark Rosser is Chief Executive at Serac Imaging Systems

www.seracimagingsystems.com