3D colour X-Ray imaging radically improved for identifying contraband, corrosion or cancer

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(Phys.org)—Scientists at The University of Manchester have developed a camera that can be used to take powerful three dimensional colour X-ray images, in near real-time, without the need for a synchrotron X-ray source.

Its ability to identify the composition of the scanned object could radically improve security screening at airports, medical imaging, aircraft maintenance, industrial inspection and geophysical exploration.

The X-Ray system developed by Professor Robert Cernik and colleagues from The School of Materials can identify chemicals and compounds such as cocaine, semtex, precious metals or radioactive materials even when they're contained inside a relatively large object like a suitcase.

The method could also be extended to detect strain in fabricated components, for example in aircraft wings, and it can be used to image corrosion processes and chemical changes.

In healthcare, the system can be used to detect abnormal tissue types from biopsy samples. In geophysical exploration it could be used to quickly analyse the content of core samples taken from bore holes.

In a recent experiment the team used the technology to X-ray a USB dongle that controls webcams. They were able to identify the different elements and components inside the dongle by analysing the energy sensitive radiographs and fluorescence patterns. The elements or components were highlighted in different colours to clearly identify them to the system operators. In this case the X-ray showed bromine, barium, silver, tin and zirconium.

The results of the tests have been published in the journal *Analyst*.

Professor Robert Cernik says: "The fact that we can now use this technology in a laboratory setting is a substantial step forward. When we first developed the idea five years ago we needed the power of a synchrotron to produce the X-Rays. In addition we only had access to silicon based detectors. This is a problem because silicon is a light atom and will not stop the high energy X-rays that come through large objects. Now we can achieve the same imaging results with an 80 x 80 pixel camera (made from cadmium zinc telluride) that supports real-time hyperspectral X-ray imaging up to very high energies."

He continues: "Current imaging systems such as spiral CAT scanners do not use all the information contained in the X-ray beam. We can use all the wavelengths present to give a colour X-ray image in a number of different imaging geometries. This method is often called hyperspectral imaging because it gives extra information about the material structure at each voxel (3D equivalent of a pixel) of the 3D image. This extra information can be used to fingerprint the material present at each point in a 3D image."

As well as providing more information about the object being X-rayed, this new technique also decreases the time it takes to create a three dimensional image. Rather than building up lots of separate images (mapping), the new system creates the image in one very simple scanning motion which now only takes several minutes.

This has implications for using the X-ray system for medical purposes, as Professor Cernik explains: "The fact the image can be taken at the same time as using more conventional methods and on the same timescale means more information can be gathered from biopsy samples. This will more accurately differentiate between normal and abnormal tissue types reducing mis-diagnosis."

Professor Cernik is now seeking industrial partners for collaborative projects to refine the X-ray technology for each specific application such as security, aerospace and medical imaging. The team is also close to creating the first colour CT scanner which could dramatically improve diagnosis for a range of conditions or improve security at airports.

More information: Paper: A laboratory system for element specific herpspectral X-ray imaging. *Analyst*.

Provided by University of Manchester

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