Detecting & Characterizing Bomb Fragments Using 3D Technology

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INTREPID Forensics
Interdisciplinary Training and Research Programme for Innovative Doctorates in Forensic Science

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Bomb Fragments in Explosion Scenes

IMPORTANCE IN CRIME SCENE RECONSTRUCTION

- Understanding what the bomb consisted of and how the explosion occurred can help establish the motive, means, and opportunity of the perpetrator
- In cases of terrorism, the group responsible for the attack may leave trademark signatures on bomb fragments

NON-DESTRUCTIVE 3D IMAGING FOR VISUALIZING BOMB FRAGMENTS

- Bomb fragments can be found scattered around the scene or embedded in victims of the blast
- Laser scanning will be used to document post-blast scenes and the associated evidence *in situ* (external imaging)
- Clinical computed tomography (CT) & micro-CT will be used to visualize fragments within soft tissue (internal imaging)

Laser Scanning for Scene Imaging

- Laser beams are emitted from the scanner, which are reflected off of objects in a scene back to the scanner
- This forms a "point cloud", which is a 3D representation of a scene made up of millions of points

Scanning a post-blast scene before any evidence is removed can help to later identify the location of bomb fragments & evidence containing bomb fragments (e.g. body parts) in relation to the bomb's location. Understanding where bomb fragments may end up can aid in establishing thorough search & recovery protocols, thus maximizing the collection of bomb fragments.

Figure 1 - A 3D image of the Crime Scene house at the University of Toronto Mississauga created using a laser scanner. *Source: Eugene Liscio, AI2-3D. (http://ai2-3d.com/)*

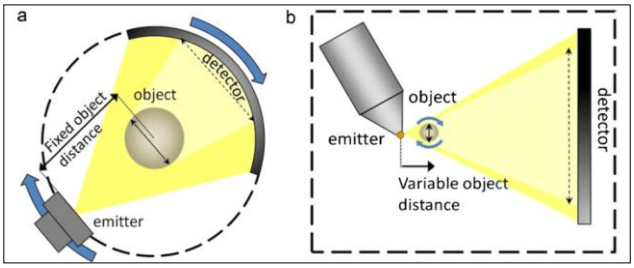

Figure 2 – (a) In a conventional CT scanner, the beam emitter & detector rotate around an object; (b) In a micro-CT scanner, they are fixed and the object instead rotates, allowing a higher resolution to be achieved.
Source: Rutty et al., 2013

Computed Tomography (CT) for Internal Imaging

- X-rays are taken from multiple views, allowing for a 3D internal image to be created
- Due to differences in radiodensity, materials can be differentiated & characterized

Clinical CT is used to determine the location of bomb fragments within the body, which is useful for the forensic pathologist for autopsy planning. Small objects, however, may not be resolvable with clinical CT. Using a micro-CT scanner, which can achieve a higher resolution, mitigates this issue. By identifying, locating, and characterizing bomb fragments & residue within soft tissue, a better understanding of the type of bomb used in the explosion can be established.

Research Method & Goals

Preliminary Tests: identify optimal parameters to scan metal with CT

- The metal components in a bomb tend to survive explosion scenes and are generally recoverable.
- Issues exist when imaging metal with a CT scanner due to beam-hardening artefacts. These issues must be resolved before experimental work begins.

Experiments: Set up bomb blasts in a controlled environment

- Both low-explosives (e.g. pipe bombs) and high-explosives (e.g. military explosives) will ideally be tested.
- Deceased pigs will be used as human analogues.

Scene documentation & evidence collection

- The scene will be documented with a laser scanner to preserve the context of the evidence.
- Bomb fragments & pig samples will be collected.

CT analyses

- The pig samples will be imaged with the conventional CT scanner.
- Areas of interest (i.e. containing small fragments, explosive residue) will be excised and imaged with the micro-CT scanner.
- The bomb fragments recovered from the scene will also be imaged to act as a comparison to the fragments within the samples.

Combining the 3D data

- The spatial data recovered from the laser scan of the post-blast scene and the spatial distribution of fragments within the pig samples as given by the CT images can be corroborated.
- Consequently, a better understanding of bomb fragmentation during the explosion can be established.

Issues with scanning metal with CT will be addressed & mitigated

A novel way of analyzing bomb blast evidence will be developed by combining external & internal 3D imaging techniques

Recommendations will be made for thorough search & recovery methods of post-blast scenes

Additional Information

To learn more about this project & the INTREPID Forensics programme, visit: http://www.intrepid-forensics.eu/project-9

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