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NIJ and University of South Carolina—Improving Detection of Crime Scenes

Infrared Camera Rapidly Identifies Blood Stains for Collection and Analysis

Moving Knowledge from Research to Impact

"This technology provides the ability to detect blood in all sorts of circumstances, even in some cases where traditional techniques can't."

Stephen Morgan, Ph.D.
Chemist and Professor
University of South Carolina

Synopsis of Problem and Solution

The detection, collection, and analysis of blood evidence recovered from a crime scene is critical in a forensic investigation because of the potential DNA it carries. However, crime scenes are often chaotic, and biological fluids can be hard to locate. The most common method for detecting blood stains is to spray a crime scene with luminol, a chemical that reacts with iron in blood to emit a blue glow that can be seen in the dark; the use of luminol has its disadvantages. It can produce false positives when reacting with many common household items, it can dilute blood samples to a level at which DNA cannot be recovered, and can smear blood spatter patterns that are often critical in determining how a victim was attacked.

With the support of the National Institute of Justice (NIJ) funding, chemist Stephen Morgan, PhD, and his team at the University of South Carolina in Columbus, SC, developed a prototype thermal infrared (IR) camera that can rapidly and selectively identify blood stains in ambient lighting without the use of reagents. The camera, which can be operated by a person with minimal technical knowledge, highlights blood stains by filtering out wavelengths that are not characteristic of blood proteins. The prototype has been refined for forensic use, with complete automation of image processing and enhanced sensitivity. Additionally, a novel infrared lamp using a heated alumina emitter was developed for active thermal infrared imaging.

Benefits

- Identifies stains that require further chemical analysis without interfering with the sample
- Detects blood even when the sample has been diluted to 1 part per 1,000
- Enables blood detection in daylight
- Preserves integrity of blood stains and spatter patterns because IR imaging is stand-off and noninvasive, and noncontact
- Protects examiners from being exposed to chemicals unnecessarily
- Easy to use, reducing the need for trained staff to be on site
- Relatively inexpensive, allowing greater access to the technology

The Future

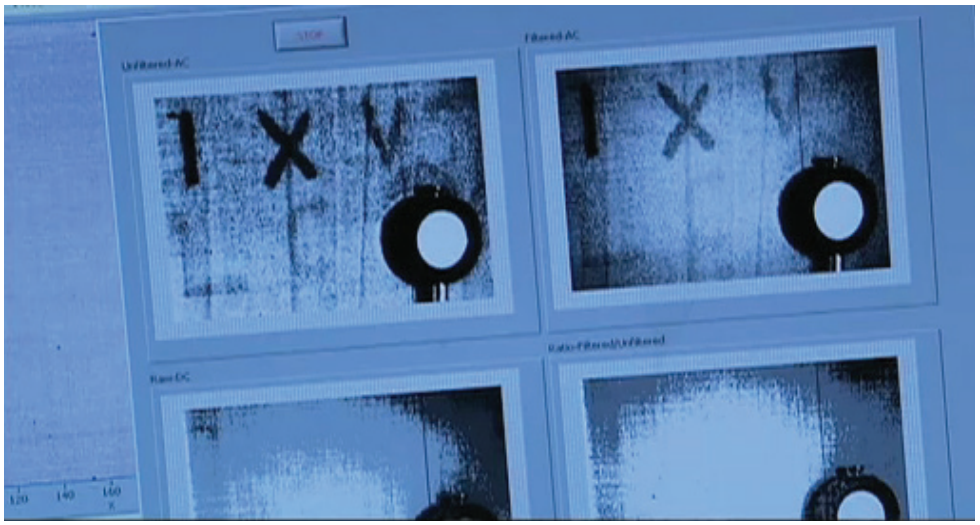
- The principal investigators are continuing to validate the technology in both laboratory conditions and with real-world crime scenes.
- With further development, the camera could also be used to identify other biological materials, such as sweat or semen, or trace materials.
- As profiling technologies advance (e.g., low copy number DNA testing), technologies like the IR camera, which are capable of finding small concentrations of biological materials, will become even more critical in crime scene forensics.

NIJ-Funded Research

Stephen Morgan, PhD, and Michael Myrick, PHD, chemists at the University of South Carolina were awarded NIJ funding to achieve a proof of concept for the development of a rapid and nondestructive tool for the visualization of blood at crime scenes using IR spectroscopy. The research focused on developing experimental details, data processing, and IR imaging performance and capabilities for detection of simulated bloodstains, and determination of limits of detection for blood using infrared measurements, determining age of blood stains, and fundamental experiments on blood detection with luminol.

Bringing Research to Practice

- In addition to the original prototype, two IR camera systems have been built that provide ease of use and automation of image data processing. One system is currently undergoing technical evaluations at the DNA processing room of the SC State Law Enforcement Division (SLED) Forensic Laboratory.
- 11 patents have been filed or awarded related to IR imaging of bloodstains.
- The PIs of the project have presented papers at 47 professional meetings based on research from the NIJ grants.
- The research resulting from this project has been published 15 times in peer-reviewed journals including Analytical Chemistry, Applied Spectroscopy, Analyst, and Applied Spectroscopy Reviews. As of March 2016, another paper has been submitted.
- Ten papers from these studies are indexed by the Web of Science and have been referenced more than 50 times by other indexed, peer-reviewed literature.



Example imagles of blood stains captured using the prototype IR camera that was developed with the support of NIJ funding.

More Information

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