DactyloGram

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DACTYLOGRAM is a unique electronic Newsletter designed to provide the reader with current information on Friction Ridge Skin Individualization, while also allowing direct access to additional resources on the WWW.

Fluorescent TiO_2 Fingerprints

This article is reprinted from the December 1, 2007 edition of the spectroscopyNOW.com, UK.

A new material that produces less background noise and higher contrast is being developed as a new fingerprinting powder for forensics. The highly fluorescent dye was synthesised using oleylamine combined with a perylene dianhydride compound and characterised by UV, NMR, and fluorescence spectroscopies before being loaded on to titania nanoparticles.

Writing in the December issue of Forensic Science International, Andrew McDonagh and colleagues at the University of Technology, Sydney and the Australian Federal Police, in Canberra, explain how fingerprints remain one of the most commonly admitted pieces of evidence in any crime investigation. Fingerprints, or marks, can be visible to the naked eye or latent. If a forensics expert has lifted a latent mark, then chemical or other enhancement is required to reveal the print adequately. McDonagh and his colleagues have now investigated the potential of a new approach to developing finger marks on typical non-porous surfaces such as glass, plastic, metal, and gloss-painted surfaces.

The researchers explain that for fingerprints on non-porous surfaces, powdering remains the technique of choice for revealing a finger mark at a crime scene. It is the nature of the powder that can be the difference between a successful prosecution and an acquittal. Using a powder that adheres to the oily or moist residue left by a suspect and forms a visible and stable print for photographing is critical.

The team has turned to nanocrystalline titania (TiO_2). This material has been widely studied because of its many and varied optical, electrical...

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> Methodology, Measurement, and Statistics

> Celebrity's Contributes to New Book of Handprints

Laser Fingerprint Scanner Does Away with Dusting

This article is reprinted from the November 16, 2007 edition of the NewScientist.com

A portable device that could scan fingerprints in microseconds has been developed by scientists in India. The system, which works using a technique called optical coherence tomography, promises to be better than existing fingerprint detection methods since it does not require any chemical processing.

Optical coherence tomography (OCT) is like an optical version of ultrasound imaging. The technique is already routinely used in medicine, but has not had a forensic application until now.

The technique provides a...

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The Maryland Fingerprint Ruling

Many are to blame for Maryland Judge's Decision

This article is reprinted from the November 8, 2007 edition of Crime Lab Report, USA.

It's a simple story about a judge who asked the right questions and didn't get the right answers. Nobody should be shocked by the outcome.

In a recent decision that sent panic throughout the forensic science community, Baltimore County Circuit Court Judge Susan Souder ruled that forensic fingerprint identification was "a subjective, untested, unverifiable identification procedure." As a result, the state was precluded from admitting the testimony of a forensic scientist who identified a suspect's fingerprints on two vehicles associated with the murder of a local store merchant. The defendant, Bryan Rose, could face the death-penalty if convicted.

Prosecutor Jason League said in court that the ruling "virtually overturns 100 years of jurisprudence with respect to the admissibility of latent fingerprint evidence."

But in her 32-page decision, Judge Souder issued a stern reminder that judges in previous Maryland cases, where fingerprint identifications were judged admissible, "were not presented with proof of erroneous identifications which refute the infallibility claimed by the State’s expert."

In the case against Bryan Rose, defense attorneys, without objection from the state, introduced a 220 page review of the FBI's highly publicized misidentification of a Muslim lawyer, Brandon Mayfield, in the investigation of the 2004 Madrid train bombing that killed 191 people. Mayfield, who was living in Oregon, was arrested by the FBI even after Spanish investigators disagreed with the fingerprint match.

Faced with compelling evidence of a significant error in a major terrorism case, Judge Souder was understandably suspicious of testimony offered by an FBI expert who claimed that the comparison of fingerprints has no potential for error. The methodology, he testified, "is infallible".

Crime Lab Report respectfully disagrees with Judge Souder's decision, but acknowledges the awkward position in which she was placed by the state's fingerprint expert. We further sympathize with Judge Souder for the blame she will receive from critics throughout the country, including forensic scientists who might be wise to tone-down their rhetoric.

Historically, forensic scientists have openly argued that the self-correcting mechanisms of our adversarial system of justice are what should be relied upon to weed out junk science and unreliable experts. In fact, during the early years of forensic science accreditation, stubborn voices from within the profession argued that accreditation was an unnecessary and intrusive process that should be reserved for the courtroom, since judges and trial lawyers are ultimately responsible for evaluating the reliability of evidence.

Now, when the same adversarial system of justice that forensic scientists have sworn allegiance to suddenly drops the hammer on scientific testimony that conflicts with known facts, forensic scientists ought to give careful consideration to ways in which their methods and court presentations can better help the judges and juries who are expecting a higher level of professionalism and credibility.

Whether or not Judge Souder's controversial decision was reasonable, the profession of forensic science has a long way to go. Serious questions remain on the minds of genuinely concerned judges and lawyers who are confused about the potential for errors in many common forensic practices. While they have good reason to be very confident in the quality pro-

duced by most crime laboratories, the continued evolution of the forensic science will hopefully be allowed to erode these doubts with the development of improved standards and new research.

In the meantime, the show must go on.

Fortunately, the calculation of error rates has never been a prerequisite of science despite what some outspoken critics of forensic science often preach.

Science is a journey, not a destination. It is a process for systematically gathering information, making observations, and using the information gained to draw conclusions or make predictions about the natural world. Research can, in many instances, help to establish error rates that will help stakeholders better understand the limitations of certain methods and techniques. But the absence of known error rates is not a justification to dismiss an entire science. The scientific method deserves more respect.

So why did the FBI botch such an important fingerprint analysis in a major terrorism case?

The answer is simple, FBI experts, like all scientists, are human beings. In the Mayfield case, they allowed themselves to become distracted by circumstances that were unrelated to the analytical work at hand. This was reported in painstaking detail by a panel of experts assigned to investigate the error.

Overwhelmingly, the misidentification of Brandon Mayfield was attributed to cultural and environmental influences associated with, among other things, "the inherent pressure of such a high profile case." With the FBI's primary focus having shifted from law enforcement to anti-terrorism activities, we have learned that the urgencies and political dynamics associated with homeland-security requires them to employ appropriate quality assurance measures to prevent similar errors from occurring in the future.

For Baltimore County, the damage had been done. While Brandon Mayfield was never actually convicted of a crime, an entire science was unfairly convicted for the errors of the FBI. No justice was served by this and it could have been avoided with a better understanding of science and the real factors that contribute to errors in crime laboratories.

Baltimore Sun reporter Chris Emery demonstrated another common misconception when he drew an inappropriate comparison between fingerprint identification and DNA testing. "DNA experts," he wrote, "typically present evidence to judges and juries noting the statistical probability of a match between two DNA samples. Fingerprint examiners, however, use a binary, all-or-nothing approach."

Statistics are often very comforting to those who naively perceive numbers to be immune from human subjectivity.

Here are the facts. DNA probabilities are not error rates. They are an expression of the likelihood that particular genetic profiles will occur within segments of the human population. Like fingerprints, the exact error rate for DNA testing is miniscule but not quantified. A DNA expert can present the most impressive statistics in court, but they won't help a judge determine if a test tube was accidentally switched or a mixture was misinterpreted from an electropherogram. Only by assessing the qualifications of the expert and the quality-assurance checks applied to the analysis can the potential for error be fully appreciated in court.

Crime Lab Report believes, however, that forensic scientists often create more problems than they solve primarily because of their own ignorance in these matters. The Maryland fingerprint decision was evidence of that.

The proposition that any scientist, method, or conclusion is infallible should be rejected on the spot. Even though scientists rarely have any reason to believe that a mistake was made, or that a mistake went undetected by the laboratory's quality assurance system, the potential for error must be acknowledged. While this may alarm some scientists, they have no reason to worry if they make good on their ethical and professional obligation to understand how errors occur and explain how those risks are mitigated. By understanding how errors happen and admitting that they are statistically possible, scientists are in a much better position to prevent them.

The expectation, however, that scientists recognize the potential for error in their work should not embolden those critics who have a disturbingly warped understanding of science. If errors were truly rampant among crime laboratories across the United States, defense attorneys would seek second opinions as often as possible. But they don't.

That's because second opinions are more likely to validate the results of the original experts assigned to these cases. It's much safer to simply attack the "science" because there is no risk of collateral damage.

Patrick Kent, chief of the Forensics Division at the Maryland Public Defender's Office, was quoted by Sun reporter Jennifer McMenamin as saying that "it is the absolute lack of even the most basic and rudimentary research…

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Letter to the Editor...

In response to an IAI Educational Conference summary published within a recent issue of DactyloGram, original presenter Glenn Langenburg provides us with the following clarification:

In the Dactylogram Vol. 2, issue 10, from October 2007, Ms. Marchant summarized two presentations that I gave at the 2007 IAI Educational Conference in San Diego, CA. With respect to the "Contextual Bias Study" that was performed, Ms. Marchant effectively summarized the results and conclusions. I might have worded the phrase "latent print examiners are...influenced by bias toward "inconclusive" and "exclusion"" less definitively, such as "the data from the experiment, under these conditions, provide evidence that examiners can be more easily influenced toward "inconclusive" and "exclusion" decisions than toward an "individualization" opinion. I think these were important findings, but more research is most definitely needed, keeping in mind that the decision making process may be quite different for the three currently accepted categorical opinions (i.e. individualization, inconclusive, exclusion).

Of a greater concern to me, however, was the summary of "Demystifying Probabilities". While I was pleased Ms. Marchant clearly followed the presentation and summarized key points, I feel that I need to address the following statements by Ms. Marchant:

This instructor stated that he no longer practices ACE-V. While he once believed this to be true, he no longer does.

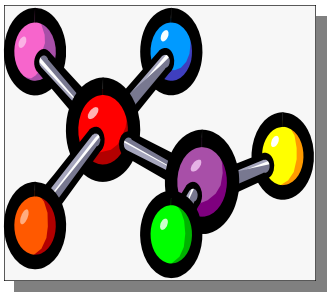
By that he meant he no longer is comfortable individualizing to the exclusion of the world's population.

This statement alone has caused a bit of consternation from friends and colleagues, and I have received a slew of emails asking if I said this!

I certainly never meant to imply that I do not utilize ACE-V. I do. I fully support the use of ACE-V as a viable protocol for forensic comparisons. Even if tomorrow we abolished categorical opinions and could only use statistics to report our evidence, we would still use ACE-V. The evaluation stage of ACE-V allows for the ultimate assessment of the strength of the corresponding and non-corresponding features. Currently, we choose to express that evidence as a qualitative categorical opinion . The use of statistics will not change the use of ACE-V, nor should it, in my opinion.

What I explored in the presentation is what has been suggested as far back as Bertillon and Locard, that assessment of corresponding features is probabilistic in nature, but we don't recognize it. We intuitively and subjectively (based on our knowledge, training, and experience) weight the features to decide which categorical opinion is most appropriate for the evidence. More importantly, as was discussed by Prof. Champod, that if we systematically study the selectivity of the features themselves, we might find that to ***truly*** exclude the world's population--that to have enough discriminating power that you actually ***can*** exclude the world's population, might be so much greater than we are currently comfortable at an operational level. As an off-the-cuff example, to call a "true individualization" it might take 20+ minutiae, dispersed over 10 or more ridges, at a minimum to reach that level. I don't know. No one does. I believe we need to systematically study the ridge arrangements to estimate where those cut-offs are. [Please keep in mind, I am excluding the situations where reliable Level 3 detail is available.]

I explored three major issues in the presentation. The first is that many of the impressions we currently feel comfortable individualizing, we may not actually have enough discriminating power to exclude the world's population. In other words, we may be "overstating" the evidence. We have a valid match, we have the right guy, but unknowingly to the examiner, there is not enough selectivity in the ridge arrangement to actually… **Concluded on page 6**



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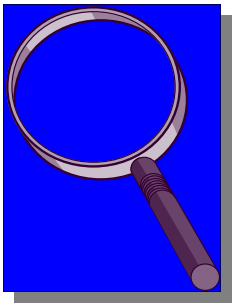
'Daubert' Link

"Fluorescent TiO_2 Fingerprints" from page 1:
...and photocatalytic properties. Previous researchers have demonstrated that suspended in methanol titania particles can enhance bloody prints on non-porous and semi-porous surfaces while others have shown titania can be used to develop prints on wet surfaces. It is possible to apply it as a paste with a brush, spray from solution, or even to submerge a piece of evidence in the reagent itself. Others have shown that it can develop prints on both the outer and sticky surface of dark colored electrical tapes and duct tapes.



However, it is its behavior in adsorbing other compounds and to act as an optical brightener that could be of interest to the forensic scientist. McDonagh and colleagues have investigated the possibilities of using titania in conjunction with the highly stable dye stuffs, perylene and perylene diamide. These common synthetic dyes come in a range of colors from red to violet and even black. More pertinent, they are highly fluorescent and photostable. "We anticipated that combining titania particles with a robust fluorescent dye bearing lipophilic substituents may increase the utility of titania in latent finger mark detection," the researchers explain.

To this end, the team has synthesized and characterized a new perylene diimide derivative from oleylamine and 3,4,9,10-perylenetetracarboxylic dianhydride. They then coated titania particles with this new dye. They have found this composite material to exhibit strong fluorescence at 650-700 nm (red) under excitation at 505 nm (greeny-blue).

In tests to reveal prints on glass surfaces, they found that their new powder produce finger mark images with so-called tertiary-level detail. The images showed very little background staining that would otherwise distort the print, something that was apparent with commercially available powders. Compared with current magnetic fluorescent powders, the new powder was slightly weaker in fluorescence intensity but produced significantly less background development, resulting in good contrast between the finger mark and the substrate. The only surface from which fingerprints could not be obtained with any clarity was a painted wood surface. The team is currently investigating other metal oxide particles for use with these and other surfaces.

Reference: M. Choi, T. Smoother, A. Martin, A. McDonagh, P. Maynard, C. Lennard, C. Roux, "Fluorescent TiO_2 powders prepared using a new perylene diimide dye: Applications in latent fingermark detection," *Forensic Science International*, Volume 173, Issue 2-3, Pages 154-160.

From page 3 ...that mandates the exclusion of fingerprints."

Ms. McMenamin would likely have ignored this sophomoric attack if she knew two important facts.

First, the amount of field-research that has been conducted in the science of fingerprint identification is overwhelming and well-documented. Studies and experiments conducted over the course of a century repeatedly fail to falsify the basic principles of the science. Numerous textbooks and peer-reviewed literature have been authored and reviewed by the relevant scientific community. Quality assurance practices continue to improve as national and international accreditation standards shape how analyses are conducted and checked for accuracy.

Second, Mr. Kent suggests that a sufficient degree of research would miraculously pacify his antagonism towards fingerprints. Even if it is possible for researchers to establish error rates for the various forensic disciplines, it wouldn't matter anyway. Defense lawyers would simply argue that the research was flawed or incomplete.

Crime Lab Report is certain that Kent and his colleagues are not interested in being pacified. It is their job to be adversaries. No amount of research will ever change that.

Latent Fingerprint Identification is a sound and reliable science in need of more competent representation when it comes under serious attack. We hope forensic science professionals in all disciplines will allow themselves to be motivated by Judge Souder's ruling and develop more effective strategies for presenting themselves and their methods in court.

Crime Lab Report urges Judge Souder to reconsider her position in the Bryan Rose case, but only after issuing a strong repudiation of expert witnesses who fail to accurately present the merits and limitations of their science.

We believe Judge Souder has an opportunity to reverse a misinformed decision and bring the Bryan Rose case to a fair and reasonable conclusion.

www.crimelabreport.com

"***Letter to the Editor"*** from page 4 …exclude the earth's population. If you went knocking on the door of every person on the planet, you might find multiple individuals with similar enough ridge arrangements, that the latent print in question could have come from any of them. I am ***not*** saying that individualizations ***cannot*** be done. A fully rolled "latent print" can easily be individualized, as it bears more than enough discriminating power in the ridges to do so. However, a small, common, delta formation with 8-10 ridge endings/birfurcations, no reliable Level 3 detail due to the quality of the latent, and consists of just 12 fragmentary ridges, may not possess sufficient discriminating features to be individualizable. Yet many experts may feel quite comfortable calling this an individualization. Those experts may even be correct in their source attribution, but after sufficient study, it might turn out many other deltas, out of the approximate 1 trillion deltas in mankind's existence, may share the exact same ridge arrangement. The experts have not made a bad match, they simply "overstated" the evidence by excluding everyone else. The second issue was that there may not be a need to go to the exclusion of all people on the planet. Why do we need to? Who is asking for a technique that to be valid must be able to exclude everyone in the world, when not everyone in the world had access to the scene of crime? Lastly, why do we as a profession place that burden on our shoulders of making such a definitive, absolute call. Again, I am not talking about source attribution. We can and should make fingerprint matches...that's what we were trained to do. Why not use tools to help guide our decision making? Why try to guess whether or not there is sufficient discriminating power in a ridge arrangement if we can develop a tool that can calculate it for us?

This was meant to be a controversial presentation. It was meant to challenge us. I expected debate about the value of such a statistical approach. I have concerns about how one would use such a tool in the United States criminal justice system. There are many questions that need additional debate and frank discussion. However, whether I use ACE-V and still report out opinions should not be a question. I still do. But I am interested in seeking alternatives to the current approach and I see real value and merit in using a statistical tool to guide my decision making process. How this is reported out or used in the courts is a matter for a larger debate.

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"Laser Fingerprint Scanner Does Away with Dusting" from page 1: ...transparent 3D structural picture by sending light though the pattern of natural secretions left on a surface by a finger and combining the reflected beam with a "reference beam" produced by bouncing light from a laser off a mirror.

This produces an interference pattern at a photodetector – the same as those found in a digital camera – which can then be used to reconstruct an image of the original fingerprint.

The new device, developed by Satish Kumar Dubey and Dalip Singh Mehta of the Indian Institute of Technology, New Delhi, is a "swept-source" OCT, which employs a rapidly scanning laser.

A key advantage of the design is that undesired reflections can be filtered out using a mathematical approach called selective Fourier filtering. This, in turn, helps the system detect fingerprints from surfaces that do not reflect light well, such as paper. Conventional techniques require chemical processing to enhance the contrast of fingerprint impressions.

The device currently uses a low frame-rate digital camera as its photodetector, so its response time is limited. "This can be improved using a high speed camera with smaller pixel size, which means the device will have the speed of a few microseconds," Mehta told New Scientist.

"OCT is a 3D instrument, hence excellent for the job," says Haida Liang, an expert on the technique, based at Nottingham Trent University in the UK. "The technique reported here is trying to image fingerprints with better sensitivity and clarity. There's certainly potential in using OCT for fingerprint detection and very little has been done on this application."

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- ***Links to the World Wide Web.***