

Watch your step—forensics close in on footwear analysis

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A left footprint. Credit: Dr James Sharp, The University of Nottingham

First it was your fingerprint that gave the game away and then DNA analysis transformed forensic science. But 'watch your step' because an expert in the School of Physics and Astronomy at The University of Nottingham has developed a new technique which could lead to a 'step change' in forensic footwear imaging.

Based on a technique known as Frustrated Total Internal Reflection (FTIR) imaging, Dr James Sharp, an expert in physical properties of thin films of polymers and biopolymers, has been able to extract additional information and create a digital picture of the personal footprint we leave behind when we stand or walk on a hard surface.

His research 'Watch your step! A frustrated total internal reflection approach to forensic footwear imaging' has been published in the open access journal *Scientific Reports*.

This new footwear analysis technique could also pave the way for other applications such as clinical studies of gait analysis or measuring how athletes interact with surfaces during high impact activities such as jumping, running or changing direction.

We all have our own individual footprint

Government policy, increasing crime rates and budget controls are increasing the pressure on forensics to speed up and make evidence gathering more efficient. So demand for low-cost imaging technology is increasing.

Much like fingerprints we all leave behind our own individual footprint. Our gait determines weight distribution as we walk. This, in turn, leads to specific wear and tear on the soles of our shoes.



A right footprint. Credit: Dr James Sharp, The University of Nottingham

Conventional FTIR maps the imprint of bare feet on a hard surface by shedding light through a transparent sheet of material as the foot hits the ground and reflecting it back at an angle. Using the same technique Dr Sharp's research group has created more detailed images of the ridges on the sole of a shoe and how these contact a hard surface.

Low cost, easy and quick

Although specific wear patterns would not necessarily be able to identify a person as the perpetrator of a crime as readily as a fingerprint or DNA it could be used to link them, or at least their shoes, to a particular location-information that could be vital to those involved in law enforcement.

Dr Sharp said: "This technique uses ideas taken from A level physics to form images of regions where shoes contact surfaces. The low cost and ease of implementation of the technique make it particularly appealing for forensic applications. We are currently in the process of working with local police forensic laboratories and the Home Office to try to develop this work further."

Practical applications for forensic services

'Watch your step! A frustrated total internal reflection approach to forensic footwear imaging' was carried out in collaboration with the East Midlands Special Operations Unit—Forensic Services (EMSOU-FS).

The EMSOU-FS were looking for a device that would allow them to collect images of contact regions of shoes to compare them with footprints at crime scenes—in much the same way as they compare fingerprints.

Charlotte Chester, Footwear Service Delivery Manager, EMSOU Forensic Services said: "The EMSOU-FS Footwear Unit is excited to be working in partnership with The University of Nottingham to develop an innovative solution to a very practical problem. Between us there is real potential to develop a footwear imaging device that would have huge impact on the forensic footwear service EMSOU-FS can provide to the five East Midlands Police Forces, an impact which ultimately affects the outcomes of criminal investigations. As a partnership we hope to work closely in the coming months to produce and test a finished product within a [criminal justice](#) setting and leading innovation in the area at a national level."

Dr Sharp is one of a number of academics at The University of Nottingham providing criminal justice expertise. The team offers a wide range of services and expertise in all aspects of the UK criminal justice sector.

More information: J. A. Needham et al. Watch your step! A frustrated total internal reflection approach to forensic footwear imaging, *Scientific Reports* (2016). [DOI: 10.1038/srep21290](https://doi.org/10.1038/srep21290)

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