Footwear forensics: CSI needs to tread carefully

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A new computer algorithm can analyze the footwear marks left at a crime scene according to clusters of footwear types, makes and tread patterns even if the imprint recorded by crime scene investigators is distorted or only a partial print.

Footwear marks are found at crime scenes much more commonly than fingerprints, writes a team from the University at Buffalo, New York, in a forthcoming issue of the *International Journal of Granular Computing, Rough Sets and* Intelligent Systems. They point out that while footprints are common they are often left unused by forensic scientists because marks may be distorted, only a partial print may be left and because of the vast number of shoe shapes and sizes. However, matching a footprint at a crime scene can quickly narrow the number of suspects and can tie different crime scenes to the same perpetrator even if other evidence is lacking.

The team, Yi Tang, Harish Kasiviswanathan and Sargur Srihari, has developed a way to group recurring patterns in a database of footwear marks to that the clustered data can be searched and compared to suspect prints much more quickly than by other techniques whether manual or computer-based. The team explains that geometric shapes including line segments, circles and ellipses can be the focus and allow the footwear to be quickly identified using an "attributed relational graph" or ARG. The attributes for every shape are defined in a way to provide scaling, rotation and translation invariance, the researchers explain. The team adds that the introduction of a measure of how different two marks

might be, which they refer to as the footwear print distance (FPD) allows them to home in on a particular boot or shoe even if the recorded print is noisy or degraded perhaps by perpetrator retracing their steps or other marks present at the scene.

The researchers have successfully tested their approach against the currently used footwear print retrieval systems used in forensic science. "In experimental runs our system has significantly higher accuracy than state-of-the-art footwear print retrieval systems," Tang says.

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