A197   Assessing the Degree of Similarity Between Accidental Patterns on Shoeprints Associated With Wearers That Participate in Shared and Independent Activities

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After attending this presentation, attendees will understand the degree of similarity between accidental characteristics based on the context in which footwear is used, how accidental characteristics change with wear over time, and how imaging science and semi-automated numerical methods can assist with comparisons.

This presentation will impact the forensic science community in many ways, from the determination of false positives and false negatives, assessing the divergence of an accidental pattern with continued wear, and gauging the reliability of using imaging science and semi-automated numerical methods to quantify the similarity in accidental patterns that vary with continued use and wearer-context.

The goal of this research is to address the similarity and change in correlation between accidental patterns that develop on the outsoles of shoes worn by individuals that participate in shared versus independent activities. To carry out this research, two groups of volunteers were solicited and provided with new/approved footwear. The first group was asked to wear the footwear while repeatedly participating in shared group activities over a seven-month period of time, while the second group was permitted to wear the approved footwear while carrying out daily independent activities. At predetermined step-intervals participants submitted their footwear for analysis, which consisted of the following data: (1) acquisition; (2) registration; (3) segmentation; (4) processing; and finally, (5) comparison. Steps 1 – 5 resulted in a 731-dimensional feature vector (per scan) that described the accidental pattern associated with each outsole. In total, 1,018 feature vectors were created, generating 34,218 pair-wise comparisons, wherein the similarity between each pattern was defined using the correlation metric. The pairwise comparisons generated six major probability density functions that describe the correlation of Known-Matches (KM), Known Non-Matches (KNM), and known-matches between feature vectors separated by continued wear.

Data analysis consisted of three phases. The first phase compared the density of similarity scores for known-matches across groups. In theory, this was a quality assurance measure since group-differences between known-matches was not anticipated. However, the results indicate that the correlation metric is sensitive to the total number and size of accidentals populating the feature vectors, which can be related to the physical size of the shoe, and the types of activities participated in while wearing the footwear. As such, it is reported that the differences in the correlation of KM comparisons across groups can be explained by the variation in shoe size, and the fact that the shared group performed restricted activities.

The second phase of data analysis compared the density of correlation scores for known-matches that differ with usage, in an effort to determine the degree to which continued wear decreases measured similarity. This question is of interest to the forensic community since exemplars worn for days or weeks after the commission of a crime may show loss and acquisition of accidentals not present on the questioned print deposited at the crime scene. The results of this study indicate that if willing to accept the chance of 1 false positive out of every 100 comparisons, then 0 miles of additional wear will lead to 99 out of 100 true positives. However, if the questioned and exemplar known-matches differ by just 10 miles of wear, the additional wear decreases the chance of obtaining a true positive to 23 in 50 for the shared group, and 43 in 50 for the independent group.

The third phase of data analysis compared the density of correlation scores for KNMs across groups. The goal was to determine if participation in a shared activity increases the similarity of accidental patterns on the outsoles of shoes worn by different individuals (and at the extreme, a rise in the number of false positive associations). The results indicate that it is likely to encounter a negative correlation 58% of the time when comparing KNMs between individuals that participate in random activities, and 64% of the time when comparing KNMs between individuals that participate in shared activities. However, when a positive correlation is computed, it is more likely to be greater in magnitude for KNMs in the shared group.

Footwear, Shared Activity, Accidentals