B148 An Investigation of Factors Affecting the Formation of 3D Fabric Imprint Patterns in Automotive Finishes

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After attending this presentation, attendees will better understand the variables involved in the formation and quality of fabric imprint patterns in automotive finishes during vehicle-pedestrian impacts.

This presentation will impact the forensic science community by providing the means to establish an alternate evidentiary link between a vehicle and pedestrian in the absence of or in conjunction with tissue or paint transfer. This evidence may also provide additional information for the purpose of reconstructing vehicle-pedestrian impacts.

In vehicle-pedestrian impacts with sufficient force, imprint patterns from clothing fabric may be formed on vehicle bumpers and in automotive finishes. Even at low speeds, hit-and-run vehicle-pedestrian impacts are far too common.[1-4] A crime laboratory's focus in the event of a hit-and-run is currently on the individualization of paint left behind by the vehicle, either on the pedestrian or in the surrounding area.[5-6] In the absence of paint evidence, or of hair and tissue on the vehicle, it is often difficult to prove an evidentiary link between the vehicle and the victim.

The goal of this study is the elucidation of pattern production mechanics — type of fabric, surface coating, angle of impact, and impact force of the vehicle—and the eventual individualization of imprint patterns to specific fabrics. Rather than crashing full-sized vehicles, this preliminary study currently utilizes a standard six-foot pendulum. A dome-shaped weld cap is mounted to the front of the pendulum arm and covered with a layer of foam, then the fabric of choice, simulating a human kneecap. The pendulum impacts a section of either a door or fender, cut to an approximate 23cm x 23cm square and mounted in a custom-built frame using C-clamps. To vary the impact force, the pendulum arm is raised or lowered by five-inch increments.

In keeping both surface coating and fabric type consistent, and performing impacts normal to the car surfaces, preliminary results do show the consistent, repeatable formation of fabric imprint patterns, provided a narrow range of pendulum heights is reached or exceeded. Precise impact force can be calculated through the analysis of high-speed video, which is currently being assembled and optimized and will be utilized in further tests repeating the above procedure. This will allow for the determination of impact force and the study of pattern variability with changing fabric type, surface coating, or angle of impact.

Initial examinations of imprint patterns have been performed with Digital Single-Lens Reflex (DSLR) photography and optical microscopy with oblique lighting. In the future, micro-level terrain mapping may be able to provide individualizing characteristics. As little research in this area has been published, this study will be supported by a survey of industry professionals. This survey is currently undergoing Institutional Review Board (IRB) evaluation prior to distribution.

Once these variables — impact force, fabric type, surface coating, and angle of impact — are fully examined on a small scale, a continuation of this study will seek to analyze a more true-to-life impact, using mannequins, an 80-foot pendulum, and full-sized vehicles.

Reference(s):

1. http://nypost.com/2015/11/06/hit-and-run-bus-driver-kills-pedestrian-in-queens/.
2. http://www.firstcoastnews.com/story/news/local/2015/11/22/fhp-hit-and-run-driver-sends-pedestrianto-hospital/76213428/.
3. http://www.latimes.com/local/lanow/la-me-ln-pedestrian-killed-studio-city-20151031-story.html.
4. http://www.chron.com/houston/article/Pedestrian-killed-in-hit-and-run-crash-in-6632190.php.
5. California Department of Justice, Bureau of Forensic Services. Physical evidence bulletin. *Collection of paint evidence.* BFS-23:1-3.
6. Lavine B.K., White C., Allen M., Fasasi A. Improving investigative lead information in the forensic examination of automotive paints. In: 40 years of chemometrics—from Bruce Kowalski to the future. *ACS Symposium Series; American Chemical Society*. Washington, DC. 2015.

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