

Bloodstain Pattern Analysis

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forensicstats.org



CSAFE 1.0 Accomplishments

Major Accomplishments:

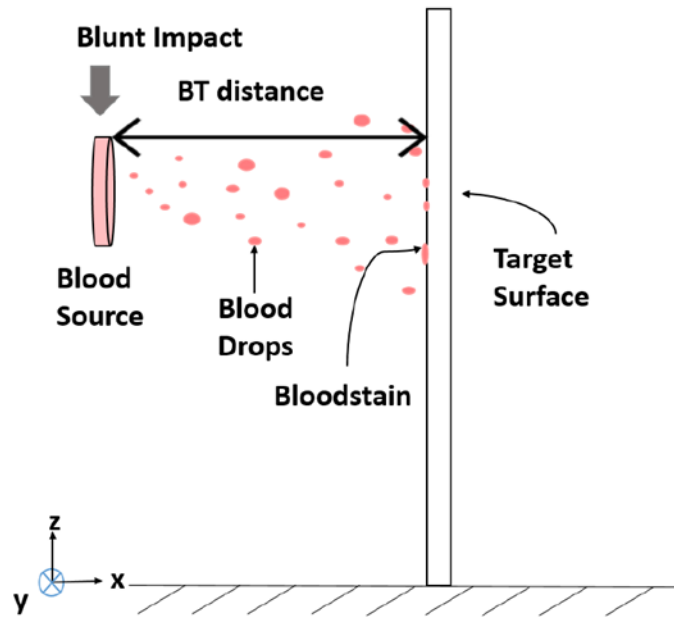
- Published two freely available datasets (impact bloodspatters) available at forensicstats.org/data
 - Attinger et al., 2018, Data in Brief – Impact beating spatters
 - Attinger et al., 2019, Data in Brief – Gunshot backspatters
- Framework for determining the region of origin of blood spatters considering fluid dynamics and statistical uncertainties (Attinger et al., 2019, Forensic Science International)
- Framework to automatically classify bloodstain patterns caused by gunshot and blunt impact at various distances (Liu et al., 2020, Journal of Forensic Sciences)
- Image processing pipeline to approximate bloodstain patterns as a set of elliptical-shaped stains (Zou et al., submitted manuscript)
- Preliminary work developing videos of blood spatter formation and statistical tools for analysis of the videos (manuscript in progress)

Impact:

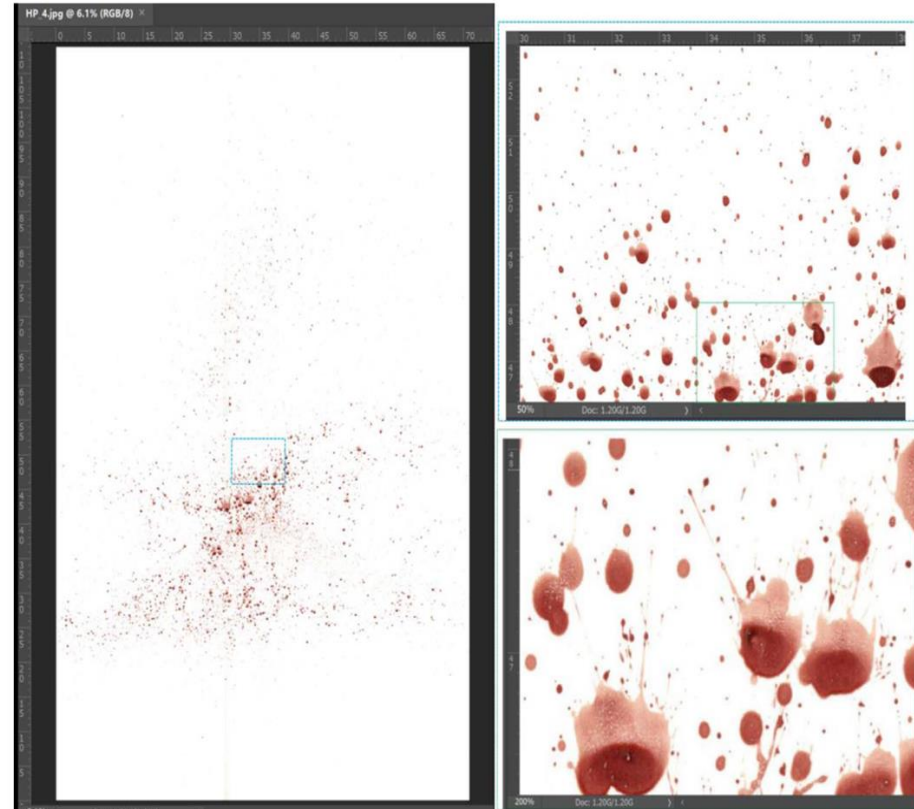
- The high-resolution blood spatter database provides a consistent set of data using controlled and carefully documented experiments available to researchers worldwide
- First work on determine of region of origin with quantification of uncertainty
- Computer based decision process for distinguishing bloodstain patterns caused by blunt or gunshot impacts

Data

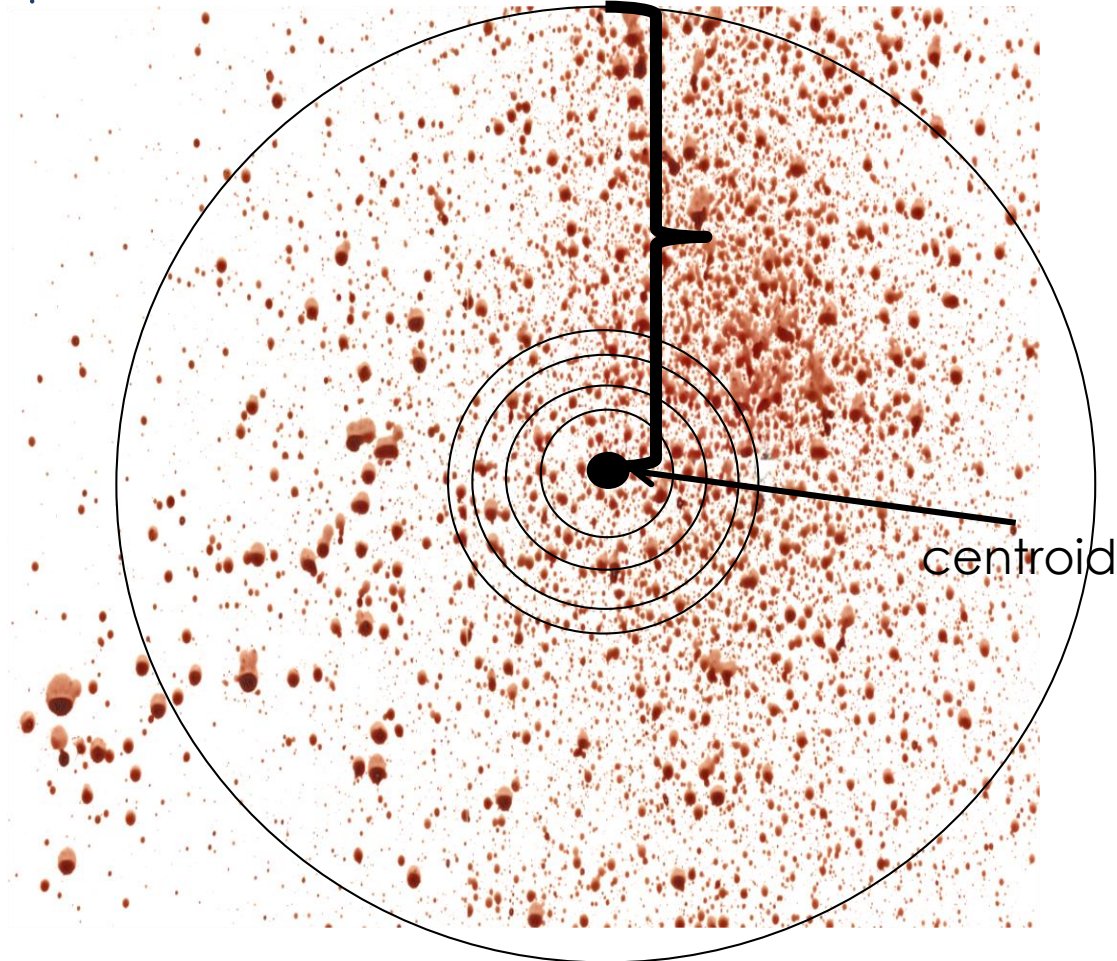
Bloodstain patterns generated by blunt impact & gunshots
(Attinger et al. 2018, 2019 in Data in Brief)



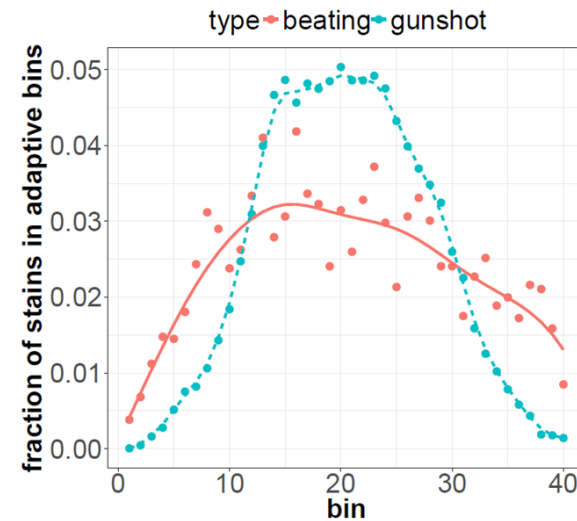
(b) Experiment setup for beating spatters.



Classification of bloodstain patterns



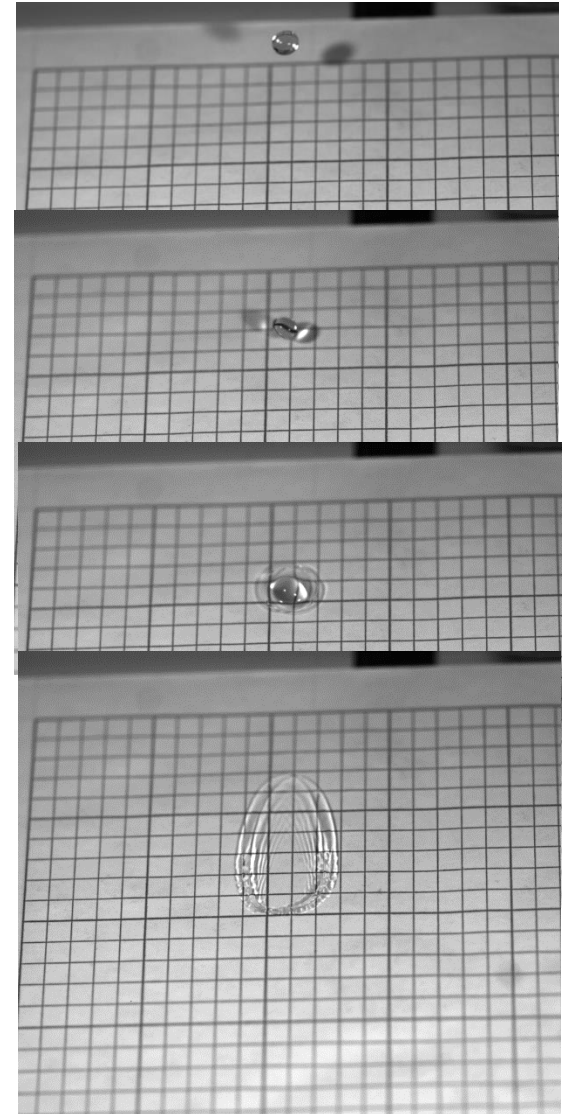
- Application of data
 - Distinguishing mechanisms
 - Examine distance of stains around center



(b) Fraction of stains in each adaptive bin and regression curves.

Experimental system to capture high-speed video of bloodspatter

- High-speed cameras to capture video of blood droplet
- Vary droplet size, angle of inclined plane
- Record size and shape of droplet over time
- Repeated measurements from same settings provide information about variability



Research Area Objectives

- Two main questions arise with BPA: determination of *mechanism* and *origin*.
- There has been limited analysis of the accuracy of bloodstain pattern analysts in determining the causal mechanism for a particular bloodstain pattern.
- Laber et al. (2014) describe the results of several studies and find many inconclusive opinions, incorrect mechanisms identified in 10% or more of cases, and the dependence of analyst performance on the context in which they carried out the analysis.
- Goal of CSAFE 2.0 research project: Develop objective analytic approaches to enhance the practice of BPA.
 - Analysis tools for bloodstain pattern images
 - Definition and refinement of relevant features to distinguish mechanisms
 - Methods and models for probabilistic analysis of mechanism and origin



CSAFE 2.0 Bloodstain Projects and Lead Investigators

BPA I- Statistical Methods for Bloodstain Pattern Analysis

Lead PI: Hal Stern, UCI

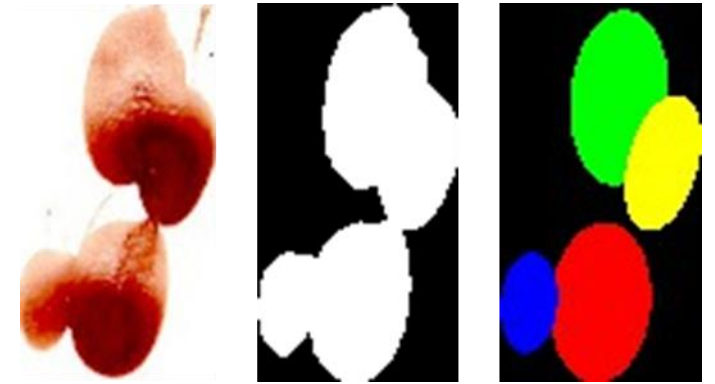
Other participants:

Kris de Brabanter, Iowa State

Tong Zou, UCI (graduate student)

Michael Taylor, EZR (New Zealand) (collaborator)

CSAFE 2.0



Proposed Activities:

- Image processing pipeline
 - Starts with a bloodstain pattern image
 - Approximates it by a collection of one or more ovoid/elliptical shapes
 - Develop features from these approximations
- Develop score-based or feature-based likelihood ratio for assessing alternative hypotheses about the mechanism causing the pattern.
 - Builds on the CSAFE 1.0 work of the Iowa State group (De Brabanter)
- Collaborate with practitioners to assess the practicality of the approach in casework.

Potential Impact:

- Current evaluation of mechanism for bloodstain pattern analysis is subjective.
- First steps in assessing a likelihood ratio approach to bloodstain pattern analysis.

Resources and Needs

- Ways forensic science community can engage/partner with us:
 - All of our data are laboratory generated; hopeful that as methods develop we can explore their potential in case-like (or case) materials