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A data set of bloodstain patterns for teaching and research in bloodstain pattern analysis: impact beating spatters

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Daniel Attinger, Yu Liu, Tyler Bybee and Kris De Brabanter

CSAFE, Iowa State University, USA
Sharing data?

HIGH SPEED DIGITAL VIDEO ANALYSIS OF BLOODSTAIN PATTERN FORMATION FROM COMMON BLOODLETTING MECHANISMS

Project Report, MFRC Project No. 06-S-02

Terry L. Laber¹, Bart P. Epstein², Michael C. Taylor³
• Those MFRC videos have been shown in dozen of BPA classes
Measuring velocities with Particle Image Velocimetry (PIV)


http://faculty.mccormick.northwestern.edu/richard-lueptow/images/fire-sprinkler.jpg

Research funded by the Center for Statistics and Applications in Forensic Evidence (CSAFE) - forensicsstats.org
Characterization: Velocities measured on MFRC movies with PIV

7Aa1: Forward spatter
Backward spatter

7Ab1:

Fig. 1. PIV results for experiment 7Aa1 are shown in panel (a), and for experiment 7Ab1 in panel (b). The red dashed line with circular data points represents the results from forward spatter, and the solid blue line with square data points is for backward spatter. The error bars are the standard deviations of the sets of data. Note that the data points are slightly offset from their corresponding time reckoned from the bullet impact moment in order to more easily distinguish the error bars. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)


Research funded by the Center for Statistics and Applications in Forensic Evidence (CSAFE) - forensicstats.org
Backspatter drops are like exploding stars

Rayleigh–Taylor instability breaks accelerated blood into drops when a heavier fluid (blood) is accelerated towards a lighter fluid (air).

Drop diameter \( d \approx \frac{\sqrt{r}}{V\theta} \sqrt{\frac{\sigma}{\rho}} \)

A database of beating spatters
61 beating experiments
Large size: up to 1.4m x 1m (56’ x 40’)

Research funded by the Center for Statistics and Applications in Forensic Evidence (CSAFE) - forensicstats.org
Two reproducible and documented generation mechanisms
Impact velocity 1-10 m/s

Hockey puck rig (HP)

Cylinders rig (C)
• April 12 - 2017
• Hockey Puck & Dowel Rig Experiment
• Designed by: D. Attinger & J. Polansky
• Performed by: J. Polansky
• Label: HPT#17
• Image Scale: 600 dpi (236.2 pixel/cm)

• Environmental conditions:
  • Room Temp=24.5 C ± 1 C
  • Room Humidity=24.7 % ± 5 %

• Blood Properties:
  • Hematocrit=36% ± 0.5 %
  • Blood Volume= 1 ml ± 0.1 ml
Documented geometry. Distance blood source and spatter from 30cm to 200m

Lower left corner of target $(x, y, z)_t$

Origin (blood pool) $(x, y, z)_o$

Research funded by the Center for Statistics and Applications in Forensic Evidence (CSAFE) - forensicstats.org
Data Article

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- Appendix A. Supplementary material Supplementary data (2zipfiles containing the bloodspatter data found in the online version) associated with this article is at http://dx.doi.org/10.1016/j.dib.2018.02.070.
Digital data can be easily processed.
Another gunshot dataset will be available soon

1-10 m/s

300-1000 m/s
Value of data

• new and original dataset
• experimental design and methods can be readily reproduced
• teaching
Print blood spatters for teaching and instructional purposes.

2017 BPA class
University of the West Indies,
Kingston, Jamaica
TOGETHER WE MOVE FORENSIC SCIENCES FORWARD

More than 60 researchers and national practitioners from across four universities and numerous research institutes work together to build strong scientific foundations that enhance forensic science and technology practices. We are statisticians, engineers, lawyers.

ALICIA L. CARRIQUIRY
DISTINGUISHED PROFESSOR, IOWA STATE UNIVERSITY | DIRECTOR OF CSAFE
Area of Expertise: Statistics, Boss

DANIEL ATTINGER
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KRIS DE BRABANTER
ASSISTANT PROFESSOR, IOWA STATE UNIVERSITY
Area of Expertise: Non-parametric Statistics

Research funded by the Center for Statistics and Applications in Forensic Evidence (CSAFE) - forensicstats.org
A scientific statement
1. is reproducible
2. can be tested
3. has a known uncertainty or error rate
• Question: “How tall is the speaker?”

• Common answer: About 5’ 10’’
• Question: “How tall is the speaker?”

• Expert answer: “178 +/-2cm, and I am correct 95% of the time when I make this statement using the method I use and given the object that I am measuring”
Classification: **beating** vs **shooting spatters**
Conclusions

• We share 61 high-resolution beating spatters
• Freely and easily available for your teaching and research

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• Yu Liu, Kris de Brabanter, Ricky Faflak, Prashant Agrawal

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