

Directional Analysis of Blood Spatter at Crime and Accident Scenes for the Private Investigator

By Louis L. Akin, LPI

Blood spatter analysis is an important part of contemporary crime scene investigation and, while not every investigator needs to become an expert at it, every investigator should at least understand the fundamental principles and procedures and be able to correctly record data at the scene for later interpretation by a blood spatter analyst.

A basic understanding of blood spatter analysis will allow the investigator to correctly collect blood stain data at the scene or from photographs of the scene and converse with the attorneys, medical examiner, and blood spatters expert regarding the blood evidence. This understanding is important, because the interpretation of blood spatter patterns and other evidence at crime scenes may reveal critically important information such as:

- The positions of the victim, assailant, and objects at the scene
- The type of weapon that was used to cause the spatter
- The number of blows, shots, stabs, etc. that occurred
- The movement and direction of victim and assailant, after bloodshed began
- It may support or contradict statements given by witnesses¹.

The investigator may use blood spatter interpretation to determine:

- What events occurred
- When and in what sequence they occurred
- Who was, or was not, there
- What did *not* occur

VELOCITIES OF BLOOD SPATTER

The velocity of blood spatter is that of the force causing the blood to move rather than of the speed of the blood itself; low velocity blood may drip from a wound as a result of gravity, while high velocity blood may be caused by a bullet moving at 900 fps.

Low Velocity

Low velocity stains are produced by an external force less than 5 fps (normal gravity) and the stains are 3mm and larger. It is usually the result of blood dripping from a person who is still, walking, or running, and sometimes from cast off. Dripping blood often falls at a 90° angle and forms a 360° stain when it hits a flat perpendicular surface, depending on the texture of the surface. Spines can be caused by drops repeatedly landing in the same place, by the distance the drop falls, or by the surface upon which the blood lands. Low velocity blood may also be found in the trail of a person who is bleeding and larger pools of blood may indicate where the person paused.

Medium Velocity

Medium blood spatter is produced by an external force of greater than 5 fps and less than 25 fps. The stains generally measure 1-3mm in size. They are often caused by blunt or sharp force trauma that is, knives, clubs, fists, and arterial spurts.

Most medium velocity blood found at crime and accident scenes will be created by blood flying from a body as the result of punching, stabbing, or in the case of an accident, the body striking surfaces inside or outside a vehicle.

High Velocity

High velocity blood spatter is produced by an external force greater than 100 fps and the stains tend to be less than 1mm. The pattern is sometimes referred to as a mist. High velocity patterns are usually created by gunshots or explosives, but may also be caused by industrial machinery or even coughing, or sneezing. In any case, the spatter tends to be tiny drops propelled into the air by an explosive force. High velocity droplets travel the least far because of the resistance of the air against their small mass.

THE THEORY OF BLOOD SPATTER INTERPRETATION

Angle of Impact

Experiments with blood have shown that blood tends to form into a sphere rather than a teardrop shape when free falling or projected in drop size volumes. When a sphere of blood strikes a flat surface the diameter of the sphere in flight will equal the width of the stain on the surface as seen in Figure 1. The following diagram will help the reader to understand the concepts being presented.

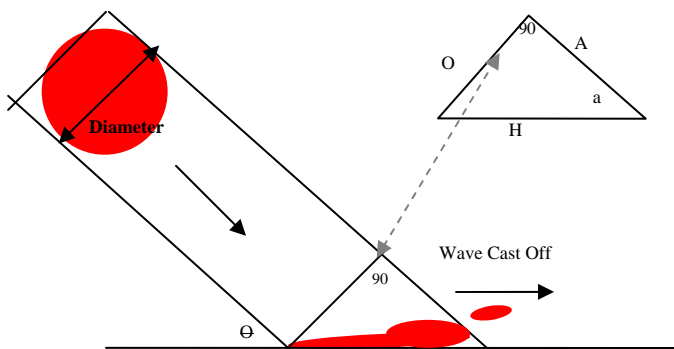


Figure 1 Side View of blood drop in air, and then striking a flat surface

Point of Convergence (POC).

The Point of Convergence or POC is the intersection where lines drawn through the center of the individual stains meet and is determined by drawing lines or strings through the long axis of individual spatters as seen in Figure 2 below.

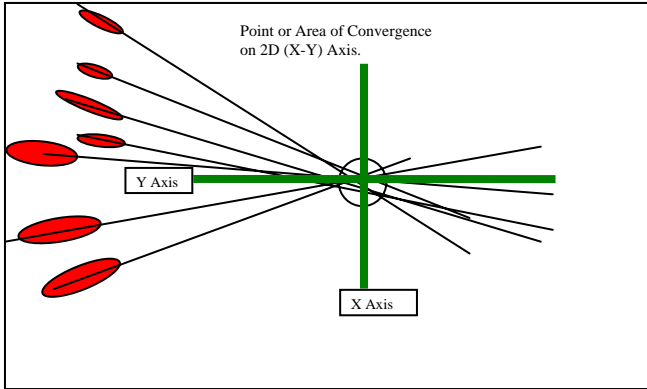


Figure 2 Lines through the central axes of the spatter cross at the Point of Convergence.

Determining the Angle of Impact (AOI)

There are two ways to calculate the AOI. The traditional way has been with a handheld calculator. The problems with the hand held calculator are that 1. It allows for entry errors, 2. The user must remember the trigonometric formulas, and 3. It doesn't store or print out the calculations so it has to be typed into a computer anyway.

The latest software technology as that produced by *On Scene Forensics* eliminates these problems. The data is posted to a screen so that errors can't be made. The software knows the formulas and does all the calculations automatically. The information is stored and can be printed, emailed, or faxed. The software produces an easily readable word document that can be used universally by any agency.

THE SOFTWARE METHOD OF ANALYSIS

When using software, performing the calculations to determine the Angle of Impact and Point of Origin are as simple as filling in the blanks. The user can forget all the information in the previous paragraphs and just enter the length and width of the representative blood stains and the distance to the Point of Convergence as seen in the illustration below and the Angle of Impact and Point of Origin appear instantly on the screen. This particular software product also calculates the trajectories of bullets from bullet holes and has an Artifact file that records each item of evidence recovered at a crime scene. The blood spatter and bullet trajectory data can be imported into diagramming programs.

Blood spatter analysis software programs range from \$149 to \$2000. The low end application by Digital.Cop costs \$149 and only calculates the angle of impact—nothing else. Any \$20 calculator will accomplish that much.

The mid-range software such as *On Scene Forensics* does all the calculations, saves a record that can be stored on hard drive or printed, costs about \$370, and requires no training. The software has the added features of bullet trajectory calculation, bullet caliber identifier. For the average PI this program is the best buy.

The more complex top-dollar software such as Back Track does all of the calculations, represents the results in a three-dimensional diagram program, and costs \$2000. Some people have complained that the high end program is too complicated to learn, but that is because of two reasons: one is the CAD ware learning curve, the other is that it does much more complex diagrams.

THE HAND HELD CALCULATOR METHOD

The Angle of Impact is the inverse arc sin of the W/L ratio, so first calculate ratio (W/L) then SIN -1 (2nd function) to get the degrees of a and AOI

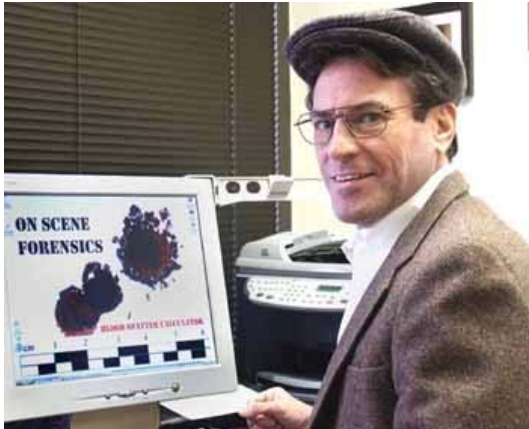
Lines drawn through the central axes of the blood drops will converge at an area that will be designated the Point of Convergence.

The Z axis is perpendicular to the surface at the Point of Convergence. It is easiest to imagine in relation to a floor in which case it would equate to the backbone of a standing person. However, the measurements are not always taken from a floor. They may be taken from a wall or the surface of a piece of furniture. In the case of a wall, the Z axis would be perpendicular to the wall. Once the point of convergence and the angles of impact have been established the next step is to locate the Point of Origin *three dimensionally* which will require a perpendicular axis.

The *Point of Origin* (PO) is located above the POC on the perpendicular axis 90 degrees perpendicular to the floor. It is the point from where the blood hemorrhaged or was disgorged from the body.

The formula to determine the Point of Origin on the Z Axis is similar to the one used to establish the Angle of Impact except that the TAN function is used. First, measure the distance from each blood stain along its central (Y) axis to the POC. Second take the TAN of the degrees AOI. Third, multiply the TAN of the AOI by the distance along the Y axis. The answer will be the height on the Z axis of the Point of Origin. **END**

Author's Biography



Louis L. Akin, LPI, a licensed professional investigator and writer in Austin Texas with 23 years experience in investigation and crime scene reconstruction. He teaches blood spatter analysis to attorneys and investigators.

ⁱ James, Stuart H, Eckert, William G. Interpretation of Bloodstain Evidence at Crime Scenes, 2nd Edition, CRC Press 1999 p10-11

ⁱ Bevel, Tom; Gardner, Ross M. Bloodstain Pattern Analysis, 2nd Ed. CRC Press 2002

ⁱ James, Stuart H, Eckert, William G. Interpretation of Bloodstain Evidence at Crime Scenes, 2nd Edition, CRC Press 1999.

ⁱ Hueske, Edward E., Shooting Incident Investigation/Reconstruction Training Manual, 2002

ⁱ Akin, Louis L., *Blood Spatter Interpretation at Crime and Accident Scenes: A Step by Step Guide for Medicolegal Investigators*, www.akininc.com

ⁱ Sutton, Paulette T., Bloodstain Pattern Interpretation, Short Course Manual, University of Tennessee, Memphis TN 1998

ⁱ Blood Spatter Analysis On Scene Forensics Software, <http://www.onsceneforensics.com> , 2005