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Pixel Sleuths

Why the fascinating world of forensic animation is ready for its close up.

This is a guest article from forensic imaging consultant Michael Mayda. Michael provides expert witness services in visibility analysis, photogrammetry and computer generated animation, and has been in business in Sacramento, California since 1977.

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What is Forensic Animation?

Forensic animation is the use of full motion computer graphics to recreate or analyze a crime or accident. The same technology and techniques behind a Disney or Pixar movie can be used to create accurate and detailed depictions of events which are admissible in court.

A well-constructed animation can be a very compelling form of legal presentation. In a classic 1992 study known as the Weiss-McGrath report, it was found that visual presentations resulted in a 100% increase in juror retention over oral presentations, while a combined visual and oral presentation resulted in a 650% increase. These findings have since been corroborated by many similar studies.

Forensic animation is particularly useful in cases where timing, position, and perspective play an important role. For instance, motor vehicle accidents, bullet trajectories and blood spatter analysis can all be illustrated to a jury more effectively through a visual re-creation of the event.

Forensic Animation Process

There are three main steps in a typical forensic animation process:

1. Collection and study of data
2. Creation of 3D models
3. Assembly and rendering of the animation

It is the first two steps that set forensic animation apart from animation for entertainment purposes. In order for the re-creation or analysis of the crime or accident to stand up in a court of law, the underlying data and 3D models must meet a high standard of accuracy.

Example Case: Motor Vehicle Accident

To get a better understanding of the process, let's walk through an example scenario, based on a real case I am currently working on for a public transportation agency. As this is an ongoing case, I have intentionally modified or left vague certain details. However, it should still serve as a good illustration of the animation process.

The case involves a motor accident that occurred in the foothills of California. It was nighttime, and the errant driver was traveling along a road that curved gently to the right. The driver misjudged the road as a straight one and crossed lanes, crashing into a car coming the other way. One person in the oncoming car was killed, and the errant driver himself was heavily injured but survived.

There was a rumble strip that ended about 200 yards before the location of the accident, and the family of the occupants of the oncoming vehicle sued the public agency, arguing that the rumble strip should have extended to and beyond the accident location. Plaintiffs claimed that the lack of a rumble strip contributed to the errant driver failing to follow the curve. The rumble strip would have alerted the driver and given him time to avoid the collision.

This is exactly the kind of case where forensic animation can be very useful, since the arguments rest on issues of distance and visibility.

Step 1: Collection and study of data

An aerial drone was used to capture 1200 still images of the scene

The first step in creating an accurate animation of the accident was to collect data about the accident scene.

Sometimes, this is possible through existing documentation, which would give us the distances between most of the relevant objects at the scene. Unfortunately, in this particular case, such detailed documentation was not available, and so we had to gather the data ourselves.

In order to do this, we compiled 1200 aerial photographs of the scene, taken by a commercial drone. This gave us views of the scene from various different angles, which could be used to triangulate the positions of key objects and road markings.

Step 2: Creation of 3D models

Photogrammetry enables 3D measurements to be derived from 2D photos

Once we had our photographs, we needed to create an accurate 3D model of the scene based on those 2D images.

The science of making measurements from photographs is known as **photogrammetry**. Photogrammetric techniques have been around since the second World War, but have only been practical for civilian purposes since the 90s, when personal computers became powerful enough to run the required software.

The gold standard here is PhotoModeler, a photogrammetric software suite I've been using since 1997. While other options exist, PhotoModeler was designed to be user-friendly to non-experts, and can run on a standard Windows PC. PhotoModeler has been used successfully for many years in forensics and accident reconstruction, and has a proven case history.

In this case, we used the UAS version of PhotoModeler, which includes tools that make drone aerial images easier and faster to process. We were able to input our 1200 still images and automatically generate a detailed 3D mesh model and very high resolution orthographic texture image of the accident scene. After some fine-tuning, our model was ready for animation.

In addition to the model, an accurate, very high definition video was produced of the scene at night, providing a visual reference for the appearance of the scene to enhance and substantiate the accuracy of the animation. Audio of road and rumble strip sounds were also recorded and measured from the vehicle's interior to be integrated with the animation's visual depiction.

Step 3: Assembly and rendering of animation

An overhead view of the accident location, re-constructed as a 3D model

At this point, we were ready to create the actual animation.

This is usually done in a standard 3D animation software suite such as Maya, Lightwave or 3DS Max. The models are placed in their relative positions and textures are applied to give them a more realistic look. Virtual lighting and cameras are placed in the scene to accurately depict visibility conditions. Then, the animator uses a technique called **keyframing** to specify the position of the object at particular frames in the animation. Once this is done, the software can be left to render the animation, “filling in the blanks” by calculating one image per animation frame.

In this particular case, the main issue of contention rested on the driver’s perception of the road at the time of the accident. Thus, we decided to go with a first-person perspective, from the point-of-view of the errant driver. This would give the jury a good sense of the driver’s visibility of the road, as well as whether the rumble strip would have given him sufficient audio warning of the oncoming curve.

In other words, the animation is able to put the jury in the metaphorical driver’s seat as the accident unfolds, giving them a much better understanding than a simple oral account can provide.

A Powerful Tool—If Used Wisely

Forensic animation has been gaining increased acceptance in courtrooms over the past few decades, as the techniques become better known over time. While some continue to stay away from the technology due to a lack of understanding, I hope this article has convinced you that animation can be a powerful presentation tool.

Of course, the strength of an animation depends critically on the accuracy of the data and 3D models used in creating it. An inaccurate animation runs the risk of being inadmissible in court, while a well-constructed animation can be the critical factor that wins you the case.

With a better understanding of forensic animation, you will be equipped to achieve a lot more of the latter.

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On The Job *is a guest opinion column written for The Forensic Gazette. It provides a glimpse into the daily lives of forensic scientists, discusses new research, and presents topics of interest to the scientific community.*

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