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## VEHICLE SAFETY

## Computer Animation and Simulation in Traffic-Accident Reconstruction

by Kenneth L. d'Entremont, Ph.D.<sup>1</sup>

*A computer-generated animation shows a passenger car approaching an intersection and colliding with a pickup truck. The accident damage and post-impact motion of the vehicles are also shown. The animation is realistic, compelling, and was produced with results from a complicated computer simulation program. The animation, however, is inconsistent with eyewitness accounts. How do you evaluate the validity of this accident reconstruction?*

### INTRODUCTION

The proliferation of powerful personal computers has been accompanied by an increase in computer animation and simulation in traffic-accident reconstruction. Inexpensive computer hardware and software has made it easy to produce animations and simulations based on faulty data and assumptions. This situation is aggravated by the blind faith which some people have in video presentations and computer technology. Therefore, computer generated results must be thoroughly evaluated due to their persuasive power.

The difference between animation and simulation is sometimes unclear. Simulation is a method of analysis; animation is a method of visualizing results.



Fig. 1 Frame from Accident Animation

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## **VISUALIZATION**

Animation is the generation of a series of still images that are played back in rapid succession to demonstrate vehicle motion as is done with motion picture frames. The data required to position vehicles within the animation may be determined from artistic judgment, hand calculations, or computer simulation. Computer animation is merely a dynamic graphic technique used to present results for ease of understanding.

Objects within animation frames can be displayed in detail ranging from crude wire-frame stick figures on the low end to the photorealistic scenery and vehicles shown in Fig. 1 at the high end. As a result, the realism contained in some computer animations is often quite graphic. However, because the motion demonstrated in an animation can come from a variety of sources, it is only as valid as the underlying analysis.

The use of computer animations also raises the issue of visibility, for example, when an animation shows what a driver would see at night or while approaching an intersection. This also invites those viewing the animation to test their perception and reaction times under artificial conditions.

## **CALCULATION**

Simulation is the calculation of vehicle motion by means of computer programs. Computer simulation software performs calculations based upon laws of nature, programmer assumptions, and user-provided input data. Such software varies greatly in scope and complexity. Some programs model multiple-vehicle collisions while many others model the dynamics of a single vehicle. Several simulation programs require minimal input data while others need a vast array of vehicle, driver, and environmental parameters. Some parameters are easily measured; however, many cannot be measured

accurately without sophisticated facilities. In some situations, driver actions such as steering and braking, are crucial inputs even though their values may never be known.

So much effort is required to determine the inputs to some computer simulations that other more decisive issues can be overlooked. These issues include the physical evidence, eyewitness accounts, and assumptions used in a computer simulation.

The output from a simulation is a set of numbers showing positions, velocities, and accelerations of vehicles at specified instants in time. Such numbers are questionable if the inputs are unsupported. It is sometimes doubtful whether a given simulation is even capable of modelling a particular accident scenario due to the equations used within it. To explore the capabilities of computer simulations, the calculated vehicle output is sometimes compared with full-scale test data — under a variety of situations and with different vehicles — to demonstrate the agreement between predicted and actual results. This process is known as validation and is important since it shows the effects of assumptions made during the development of the simulation program.

## **SUMMARY**

Remember that any weakness in an accident reconstruction generated by computer simulation will transfer to an animation which uses the simulation results. This is true whether vehicle motion is displayed crudely or in great detail. Unless key issues in computer simulation are addressed adequately including simulation capability, validation, and input quality, an animation based on such results may be nothing more than an academic exercise regardless of how visually compelling it is.