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Lightning arising from transportation-related accidents, particularly involving aviation, often presents complex facts patterns and esoteric technical issues. These plus all the data from various sources describing an accident can easily bewilder juries. But this obstacle can be overcome through the use of photorealistic computer graphics.

The effective use of computer graphics to present airplane-cash data was definitively established during the 1989 liability trial resulting from the crash of Delta Flight 191 at Dallas/Ft. Worth Airport on August 2, 1985.

The crash occurred when the L-1011 aircraft encountered wind shear while landing. Extensive use of computer graphics by counsel for Delta and counsel for the air traffic controllers helped the court to find that the sole proximate cause of the crash was the failure of the pilots to recognize and avoid a thunderstorm and to properly fly the aircraft once wind shear was encountered.

In a number of trials since, many not involving aviation, attorneys have used computer graphics to coherently and persuasively present complex fact patterns or difficult technical issues. To date, the computer graphics used during trials have merely reconstructed events by depicting information describing the event without trying to duplicate the real-world appearance of the event itself—with good reason. The computing power needed for this has only recently moved beyond scientific experimentation to commercial application. The resulting photorealistic computer graphics are now an option for litigation.

In contrast to earlier graphics—limited largely to the construction, position, and translation (movement) of shapes or objects in two- or three-dimensional space—photorealistic computer graphics also can illustrate several other factors. These include natural light sources; the effects of light, such as highlights, on the surfaces of objects; shadows and reflections of other objects; artificial or natural environments such as city streets or mountain valleys; and the effects of natural phenomena like clouds, rain, snow, or haze.

Accurately depicting these factors requires substantial computing power, particularly if a dynamic graphic with one or more moving objects is desired. Even depicting a static object with accurate lighting, shadows, and highlights taxes the capabilities of the most powerful desktop computers.

Photorealistic depiction of a dynamic environment with many moving objects, terrain features, clouds, and flowing water, for example, requires enormous computing power still available only on dedicated mainframe computer graphics systems. These systems draw on multiple databases to obtain the necessary information, which then is simultaneously processed for terrain and other features. The information is combined only in the final stage to achieve photorealistic appearance. The resulting images can be striking. (See Figures 1-3.)

Production Costs and Benefits

The cost of producing these images can vary greatly. Photorealistic depiction of a static object can be accomplished at minimal expense using one of many computer-aided design software programs, such as Cadkey and Auto Cad, that are commercially available for under $1,000. These operate on a wide range of 486 desktop computers available for under $5,000 from IBM, AST, Gateway, and other companies.

Basic animation of a photorealistic depiction to show how an object operates or fails to operate requires additional equipment to store and record the images for later playback. The resources of a computer graphic production company are usually necessary at this point. In virtually all cases, however, photorealistic depiction and basic animation of a simple object can be accomplished for under $5,000. In contrast, showing a dynamic environment with many moving objects and terrain features can cost $50,000 or more, depending on scene density, number of dynamic objects, and duration of the computer graphic.

But the benefits of these graphics can easily outweigh the costs. At the basic end of the spectrum, photorealistic depiction of simple objects—whether static or dynamic—adds relatively little cost to producing an ordinary computer graphic but refines the presentation to a level ju-

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rors may find more persuasive. The mere fact that one graphic looks more real than another may enhance its credibility. Jurors simply find it easier to believe evidence that closely resembles their own world.

At the most sophisticated end of the spectrum, some fact patterns are so complex that they can best be understood through physical re-creation. These patterns can involve the perceptual or physical abilities of participants, their reaction times, or the physical appearance of an event. Ordinary computer graphics cannot show physical appearance with enough fidelity to constitute a re-creation; they merely reconstruct events or objects through descriptive data. The distinction is subtle but significant.

For cases involving complex facts, photorealistic computer graphics can provide a powerful alternative to physical or video re-enactment or site visitation. Often this is the only viable option for recreating something that is non-reproducible, like an aircraft accident. These situations typically arise in litigation involving aviation and other transportation accidents, products liability or toxic torts, patent infringements, or professional liability of engineers.

The value of photorealistic computer graphics in these situations is apparent. Important testimony can be dramatically illustrated—particularly that of participants, eyewitnesses, or experts—enhancing its credibility. Counsel can depose witnesses more effectively by "transporting" them back to the accident scene. Similarly, witnesses and experts can be better prepared for testimony. Cross-examination of fact witnesses or opposing experts can be more thorough. Subtle relationships between evidence can be illustrated. Alternate event scenarios can be examined without a great increase in cost.

Photorealistic computer graphics can contribute to settlement negotiations by providing counsel with a depiction of a case's strengths and weaknesses. Through proper creation of a record, these graphics can also be of substantial benefit during appeal.

This technology must be approached with caution, however. It is not an automatically accepted technique. Photorealistic computer graphics, because of the detail and realism they deliver, are subject to an even greater range of evidentiary challenges than are ordinary computer graphics. Therefore, their production and admission into evidence must receive scrupulous attention to detail.

Counsel should give particular attention to Rules 901, 401, 402, 403, and 702-705 of the Federal Rules of Evidence.

As with ordinary computer graphics, production should begin early in the case so that counsel can resolve problems and avoid errors that inevitably result from last-minute preparation. Production time is directly related to the material's length and complexity. Production time can vary from a few days for a simple static graphic to months for material containing multiple moving objects and dense scenes. An added benefit of early production is the early availability of the material to help counsel understand the case's strengths and weaknesses and to set the order in which visual concepts should be conveyed.

Accuracy of Evidence

The presentation itself must be accurate and non-prejudicial. This requires first a visual depiction that conforms exactly not only to underlying data but also to the real-world appearance of the
subject matter as perceived by any eyewitnesses and as indicated by physical evidence. For example, in a weather-related aviation accident, radar data may indicate the presence of a strong storm cell. But not all storm cells produce rain. Thus, a photorealistic computer graphic showing zero visibility due to intense rainfall would be rendered useless if eyewitnesses had seen no rain and none had been recorded by weather observers. The need for attention to physical evidence and the observations of eyewitnesses cannot be overemphasized.

If an element of the presentation distorts representation of the subject matter by omission of selected details, the value of the computer graphic is compromised. Relevant information must be presented even if not necessarily material to the proponent’s theory of the case. To do otherwise would open the graphic’s photorealism to challenge. As with any other exhibit, photorealistic computer graphics must be accurate, fair, and complete.

These graphics may be presented in court through either videotape or laser-disc recording. Unlike ordinary computer graphics, the extensive computer requirements necessary to produce photorealistic graphics preclude bringing a computer system into court. Videotape is the most popular choice. It is inexpensive and effective enough in most situations. It is a medium already familiar to the judge and jurors. Videotapes can easily be edited or updated as this becomes necessary.

Videotape, however, often lacks sufficient resolution for large-screen projection or stable freeze-frame. It also lacks flexibility in that fast-forward and reverse are usually too cumbersome to compare one segment with another.

The laser-disc method overcomes these obstacles. At a minimum, laser-disc recording adds $2,000 to production costs and requires extra time. But the rewards of using it go beyond superior resolution; they extend to the attorney’s ability to interact with the computer graphics. This is done through direct access to any of the 54,000 separate image frames on each side of the disc.

Using laser-disc technology, attorneys can display varying presentations of photorealistic computer graphics in court. Documentary evidence and even photographs can be interwoven with the computer graphics. Side-by-side comparison of actual photographs with photorealistic computer graphics of the same scene can further show the extraordinary realism of this technology, providing a potent means of persuading jurors.

Evidentiary Foundation

The evidentiary foundation required for these graphics does not differ measurably from that necessary for ordinary computer graphics. The foundation
should establish the accuracy of
- the original source data,
- all calculations and assumptions
  used in processing the data,
- the method of inputting data into
  the graphics computer,
- the operation and capability of the
  graphics computer and all associated
  software,
- the output process for the computer
  graphics,
- the medium by which the graphics
  are reproduced for presentation at trial,
  and
- the final presentation itself.

Under most circumstances, counsel
should consider a pre-trial stipulation to
joint admissibility of computer graphics
prepared by all parties. Absent a stipula-
tion, counsel may wish to make a mo-
tion in limine on admissibility to avoid
disruption of the trial.

Photorealistic computer graphics are
an unprecedented tool capable of
bringing the real world into the court-
room. Although the cost is substantial
for most applications, it is comparable
to the cost of ordinary computer graphics
only a few years ago.

The rapid development of computer
technology has lowered the cost of
ordinary computer graphics to a level
that is now attractive for even moder-
ate-size litigation. As a result, ordinary
computer graphics are becoming com-
mon in the nation’s courtrooms. Pho-
torealistic computer graphics will likely
follow.

Notes
1 In re Air Crash Disaster at Dallas/Ft. Worth
Airport on August 2, 1985, 720 F. Supp. 1258
(N.D. Tex. 1989), aff’ed, 919 F.2d 1079 (5th
Cir.), cert. denied, 112 S. Ct. 622 (1992); see also
Roy Krieger, New Dimensions in Litigation:
Computer Generated Videographics Enter Court-

2 See, e.g., In re Air Crash at Detroit Metro
Airport, 791 F. Supp. 1204 (E.D. Mich. 1992);
People v. Mitchell, No. 12462 (Cal., Marin
County Super. Ct. 1992); New Jersey v. Spoth,
No. 8G126/903 (N.J., Bergen County Super.
Ct. 1992); Arizona v. Phillips, No. 87-365

3 Generally, a system based on a 486 processor
running at a minimum of 25 megahertz is
required. It is anticipated that release of the
new "P5" processor card in 1993 will substan-
tially increase the capability of desktop systems
to produce static photorealistic computer
graphics.

4 Terrain map is prepared from data derived from
the Defense Mapping Agency/Digital Terrain
Elevation Database. The map is then covered
with geo-specific texture derived from satellite
imagery or low-level aerial photography, de-
pending on the resolution desired. Simultane-
ously, the shape and placement of textures like
structures are derived from the same database
or from photogrammetry. The data for both
terrain and features are then combined to form
photorealistic images of a specific location.
These images can be generated in real time to
produce animation. The entire process requires
about 48 hours of preparation time.

5 See Martin F. Kaplan, Cognitive Processes in the
Individual Jury, in THE PSYCHOLOGY OF
THE COURTROOM 197-217 (Norbert Kerr