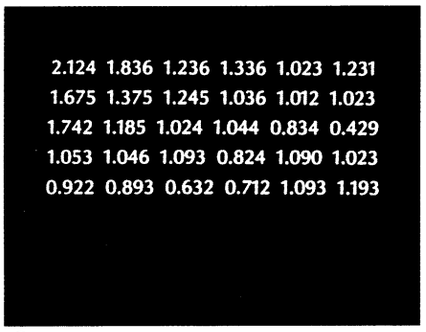
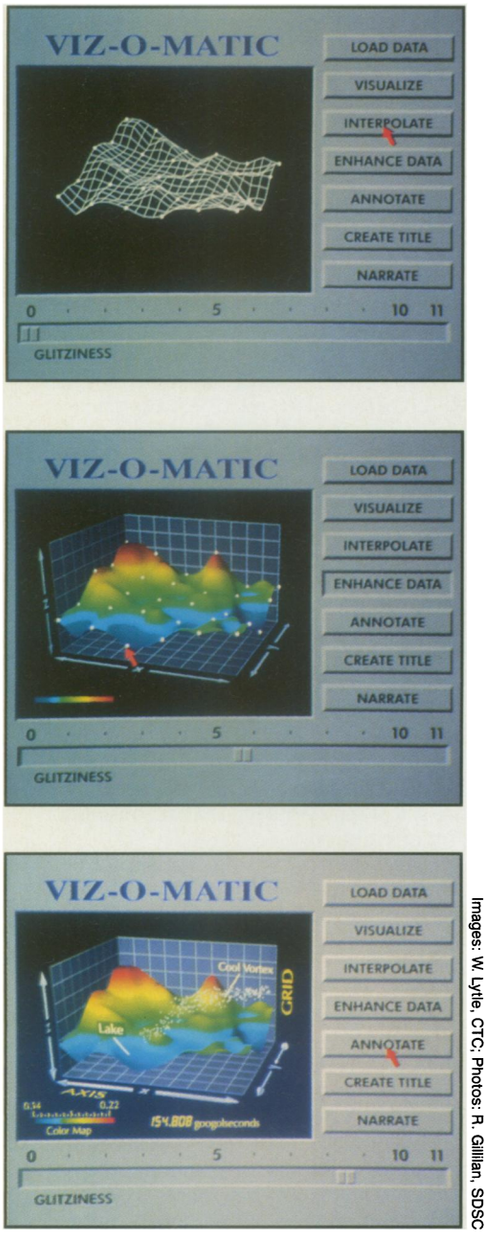


Starting with just 30 numbers . . .

Going for GLITZ

. . . and other perils of scientific visualization

By IVARS PETERSON



Images: W. Lytle, CTC; Photos: R. Gillilan, SDSC

Scenes from Wayne Lytle's animation "The Dangers of Glitziness . . ."

Wayne Lytle's demonstration of his slick visualization software starts off innocently enough. And Viz-O-Matic's on-screen commands make it all too easy to proceed.

LOAD DATA: A block of 30 numbers — white digits against a stark, black background — appears on an uncluttered display.

VISUALIZE: A rectangular grid materializes, then crinkles into a jagged, three-dimensional landscape in which the heights at various points correspond to the original numbers.

INTERPOLATE: The ragged contours smooth themselves into gently undulating terrain. Increasing the glitziness level from 0 to 5.6 paints the landscape in vivid hues, from red-tinged peaks to blue-bottomed valleys.

ENHANCE DATA: Two data points look out of place; one peak is raised, a hollow deepened. As the glitziness scale climbs to 8.4, the entire scene begins to rock gently from side to side. A stream of tracer particles — a vagrant cloud of overweight snowflakes — wanders down the slopes.

ANNOTATE: Uninformative labels and cryptic scales flash into view. Time passes in units of googolseconds.

CREATE TITLE: Trickles of insipid music accompany the appearance of a lengthy, jargon-laden heading.

NARRATE: An unintelligible, droning voice adds to the aural and visual cacophony. As Viz-O-Matic's glitziness level rises to 10, the landscape itself begins to flutter, like a flag waving in an uncertain breeze.

Lytle's sly spoof of scientific visualization lasts just 60 seconds. Yet it deftly captures many of the concerns that scientists and graphics professionals share about the overuse or inappropriate use of computer graphics techniques for visualizing scientific data.

"Scientific visualization should enhance our knowledge of a given phenomenon, not draw attention to the graphics techniques themselves or, worse, deceive the viewer," Lytle says. "Viz-O-Matic is a fictitious software package that automatically produces bad visualization."

He speaks from five years of experience as a visualization specialist at the Cornell Theory Center at Cornell University. Over the years, Lytle has helped scientists create animations representing gravity maps of the Martian moon Phobos, planets orbiting a pulsar, and laser pulses destroying an eye tumor, among other phenomena. He has also produced inventive animations ingeniously tuned to music of his own composition.

Called "The Dangers of Glitziness and Other Visualization Faux Pas," Lytle's brief, animated parody of scientific graphics was prepared for and presented at SIGGRAPH 93, held in August in Anaheim, Calif. This annual conference serves as the leading forum for computer graphics research.

"I specifically had SIGGRAPH in mind because I knew this was the audience that would appreciate hearing the message," Lytle says. "There are all kinds of mistakes possible, and I tried to incorporate as many as I could."

His animation proved one of the biggest hits of the meeting. Everybody thought it was hilarious, says Mike Bailey, manager of the visualization group at the San Diego Supercomputer Center. More than a few of these viewers may have recognized in the film's exaggerations some of their own transgressions.

Not so long ago, scientists had to be content with studying and presenting their data in simple charts, tables, graphs, and other rudimentary forms. But these techniques have faltered lately in the face of a rapidly swelling ocean of data — from satellite observations of Earth, from massive detectors focused on high-energy collisions between elementary particles, from supercomputer simulations of complex physical phenomena, and from many other sources.

So researchers have turned increasingly to new, computer-intensive methods of visualizing data in order to sort out information, extract meaningful results, and gain important insights. Powerful desktop computers coupled with sophisticated scientific visualization

software now allow scientists to explore their data so they can pick out regions of interest – to find the nuggets buried in the numerical sediment.

But treacherous potholes lie in wait for the unwary user speeding along this particular road to understanding. It's easy to get caught up in the graphics candy store and to forget the scientific purpose of such representations. Sometimes the results really do look too good to be true.

This issue came up at a workshop held last February at the San Diego Supercomputer Center, which brought together the visualization staffs from the four national supercomputing centers funded by the National Science Foundation. "Everyone agreed that you could be overglitzy and that you could hide the data more than reveal it," Bailey notes.

From their own experience, workshop participants could cite a variety of examples of the kinds of problems that sometimes arise, ranging from the cavalier treatment of data to the careful selection of viewpoint to hide an unwelcome feature. Often, the scientist or visualizer has no intent to deceive but merely wishes to make an attractive picture or to present a compelling argument.

"I think we have all seen cases where there was a very small amount of data, but the sparseness of the data was not clear in the final visualization," says Joel Welling of the Pittsburgh Supercomputing Center. Similarly, viewers aren't always told whether the data were smoothed or massaged in some way or the angle of view specially chosen, he adds.

"There's a huge bag of tricks for revealing insights – exaggerating color or scale, for example," Bailey says. "But if you need to do it, you've got to document it."

At the same time, visualization experts themselves don't mind showing off a little, especially when their work appears at SIGGRAPH, where scientific visualization shares the stage with dancing raisins and Hollywood dinosaurs.

The workshop discussion prompted Welling to propose and circulate a set of guidelines for doing scientific visualization. His rules range from the obvious but still sometimes forgotten (for example, providing time scales and units of measurement) to the subtle (such as ensuring that visualizations drawn and choreographed from scratch don't give the impression they are based on physical law).

In essence, Welling's guidelines represent a call for full disclosure – a kind of truth-in-packaging for scientific visualization.

The same discussion inspired Lytle to capture these concerns on film. "I decided that one interesting way to bring even more attention to this would be to do a spoof of scientific visualization," Lytle says.

Using Wavefront software to draw and color his images and his own Animation Development Environment software to choreograph the motion, Lytle spent several months creating his little caricature of visualization, carefully fitting its elements into a compact, minute-long package.

From unnecessary glitziness to unintelligible narration, "it's all typical stuff that poor scientific visualization shows," Lytle says. "I'm hoping viewers will not only laugh, but think twice about making the same mistakes."

His creation has certainly attracted attention. "It really is a wonderful piece," Welling says. "I'm going to add it to my classes on how to do graphics."

Viz-O-Matic's glitziness level climbs beyond 10 into the super-glitz range.

The landscape acquires a metallic, phantasmagorical sheen. The background colors oscillate from one eye-popping shade to another. The whole scene begins to gyrate wildly as if it were desperately trying to escape the screen.

Suddenly, the display freezes and an error message appears: Glitz buffer overload. Reboot. □