How Visualization Applications Drive Tool Selection:
One Product Can’t Do It All

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Abstract
Different projects, levels of ability and individual preferences all influence how people will use visualization and data analysis technology. Some users will prefer command-level interfaces, some will want point-and-click style interfaces and still others will want combinations of both. No single user interface style will satisfy all the needs of all the users in the technical community. Similarly, different projects will require different analytical techniques, not all of which can possibly be provided by a single product. This panel provides a look at the role visualization and visual data analysis plays in the technical community today, specifically focusing on the premise that the wide variety of applications for visualization mandate a need for a variety of visualization software packages.

Introduction
Our next decade of scientific research will no doubt present some unique challenges never fathomed by any generation before us. Among these challenges is the huge amounts of scientific data that will confront us daily - data from a tremendous variety of sources ranging from satellites and seismic sensors to huge, supercomputer-based simulations. Although the practice of analyzing and visualizing scientific phenomena has developed rapidly in recent years, vast amounts of data which are important to our quality of life, national security, or commercial survival go unreviewed due to the lack of cost-effective and efficient tools for their analysis. Computational power is available - today’s workstation vendors have made tremendous strides, delivering much greater power at a much lower price - what is lacking is software and techniques that can help researchers who may be less sophisticated computer users gain insight into problems across a broader spectrum of applications.

Visualization for the Masses
Visualization software has recently emerged as an important tool to accelerate the search for trends and patterns in technical data. By leveraging the tremendous compute and graphics power found in modern workstation environments, visualization has made significant contributions toward carving into the data that confronts the technical community daily. However, to date, visualization technology has been relatively unavailable to the vast majority of scientists and engineers. This is because it has only been useful by a very narrow subset of highly sophisticated “computo-philic” scientists who are fortunate enough to have access to very high performance and expensive graphics and computing platforms, coupled with an interest and ability to write their own programs to drive these systems. Furthermore, visualization has been limited to graphical solutions in data interpretation - seeing the unseen - while virtually ignoring the need for analytical tools in the same discovery process.

As visualization environments mature, they are beginning to focus more on integrating the analytical and visual technologies into more “complete” data interpretation systems. For example, AVS and Paragon have recently announced the integration of Paragon’s imaging algorithms into the AVS environment, providing more specialized tools for analysis of image data. Also, a variety of new user interfaces are emerging for visualization software, letting a wider range of users than ever before make use of these powerful new tools. PV-WAVE, visual data analysis software from Precision Visuals, while once available for command-oriented users only, is now available with a point and click style user interface, making it much easier for less sophisticated scientists and engineers to benefit from powerful visualization technology. Similarly, products from Spyglass, Inc. run on Macintoshes, supporting the famous MAC interface for their visualization tools. By combining elements of traditional and state-of-the-art visual and analytical techniques with a wider array of user interface...
choices, these systems provide unique new ways for more scientists and engineers to interpret larger amounts of data more quickly.

Different projects, levels of ability and individual preferences all influence how people will use visualization and data analysis technology. Some users will prefer command-level interfaces, some will want point-and-click style interfaces and still others will want combinations of both. No single user interface style will satisfy all the needs of all the users in the technical community. Similarly, different projects will require different analytical techniques, not all of which can possibly be provided by a single product. Furthermore, vendors must maintain compatibility with existing hardware while keeping a watchful eye to the future in a rapidly evolving hardware environment. This will be necessary as a whole new generation of hardware is developed specifically to better handle the complex needs and huge power requirements of visual data analysis applications.

Since the primary goal of visualization and data analysis software is to reduce the mean time it takes users to get information from raw technical data, a broad range of interactive technologies are crucial to the effectiveness of a product in accelerating the process of discovery and therefore to its usefulness. These include a well-defined set of graphics and visualization tools for visually interpreting the data and producing hardcopy of the results; analysis tools for better understanding of the data; data management tools for subsetting, reducing, saving and restoring the data; and data access techniques to help get the data into and out of the visual data analysis environment. These technologies must be usable by a broad range of users with a tremendous variety of application requirements with access to many types of computing platforms, from the most common, "everyday" workstations, such as those available from Sun, DEC, IBM and HP and "older" (but still important) VAX computers to the most modern and powerful specialized visualization engines from Stardent and Silicon Graphics.

Eight Golden Rules

Regardless of user style, industry or application, to benefit most from a software product, there are eight "Golden Rules" that should be considered when matching visual data analysis software to the needs of a user and an application:

1. The software must be easy to learn and use, as defined by the targeted users' preference or ability.

2. It must be easy to get your data into and out of the system.

3. The product should provide a complete set of general features and functions, all tightly coupled into a seamlessly integrated environment.

4. The product should be "open," allowing for easy extensibility and customization as dictated by the specific targeted application.

5. The software must work effectively in available computing environments as well as those planned for future applications.

6. The software must deliver very high computational and graphics speed, on computers that are available to the user.

7. The product must be affordable, based on a project's budget and expected return on investment.

8. The vendor must be committed to prompt, effective user support.

This panel provides a look at the role visualization and visual data analysis plays in the technical community today, specifically focusing on the premise that the wide variety of applications for visualization mandate a need for a variety of visualization software packages. Panelists from the journalistic, academic, research and commercial user communities will explore some of the packages available today and suggest key characteristics that might make one product stronger than another for specific application needs. The panelists will also offer their views on the future directions of visualization technology.

Conclusion

The potential for modern science to generate data truly stretches the imagination. Everything from tracking weather patterns to observing the moons of Jupiter to looking deep inside the complexities of molecular structures adds to this data overload. In addition, modern, high-speed computers can massage this torrent of data and generate billions of new numbers, producing volumes of data that cannot possibly be analyzed using conventional techniques.
It is no wonder, then, that researchers feel frustrated when their primary missions are constantly put on hold while they search for new ways to extract meaning from their data. Visualization and visual data analysis software was developed in response to this frustration. With these tools, scientists, engineers and other researchers can spend less time on the more mundane tasks of programming their own solutions and more of their valuable time on their primary missions—discovering, designing and solving problems.