Many technical authors have expounded on visualization’s role in science, engineering, medicine, and business. Recently, widespread enthusiasm prompted the development of visualization technology that has already revolutionized the way scientists do science, the way engineers design, and the way physicians deliver health care.

R&D in visualization has most visibly affected user interfaces for numerous computer-aided tasks in which human participation is essential. Scientists, engineers, and physicians have teamed up with “visioneers” (computer scientists or cognitive engineers working in visualization) to bring visualization tools into the lab, office, and clinic. These tools generate visuals from large and complex datasets, and help users interactively interpret them.

Visioneers draw upon techniques from the related fields of computer graphics, user interfaces, image processing, computer vision, signal processing, and computer-aided design. These fields—arguably the foundations of visualization—have begun to benefit from reciprocity as visualization matures. Foundation-field scientists use techniques developed by visioneers, and their journals and conferences often quote from or publish papers on visualization. Moreover, as a technology, visualization has the potential to revolutionize these fields. For example, researchers have suggested volume visualization and voxel-based processing—volume graphics—as an alternative to the traditional 3D surface graphics approach. Just as raster graphics in the seventies superseded vector graphics for visualizing surfaces, volume graphics could supersede surface graphics for handling and visualizing volumes, and for modeling and rendering synthetic scenes composed of surfaces.

Another example occurs in computer-aided design. Geometric modeling researchers have developed a wealth of technology for free-form surface representation over the years, but the acceptance and everyday use of this technology has encountered some justifiable barriers. Engineers are not ready to give up the security that a physical model provides. No one doubts the results of tests on a physical model, but many suspect the accuracy of a computer model. Moreover, conventional computer graphics renderings of surface models are not sufficient to adequately assess the model’s integrity. This is where research in visualization comes in. Surface interrogation techniques, flow visualization techniques, and other reliable visualization methods are eliminating these barriers and thus allowing better exploitation of a substantial knowledge base in geometric modeling.

This special issue of *CG&A* contains six articles that significantly update and extend papers from Visualization 92, held October 19-23, 1992, in Boston, Massachusetts. The visualization conference series was inspired by and is sponsored by the IEEE Computer Society Technical Committee on Computer Graphics in cooperation with Siggraph. The conference covers all aspects of visualization, with a focus on interdisciplinary techniques. It provides a forum for discussion among visioneers and visualization users. Continuing the successful format of the 1990 and 1991 conferences, Visualization 92 saw close to 500 participants in paper sessions, panel sessions, case studies, tutorials, workshops, and demonstrations.

This special issue is a snapshot of the state of the art in visualization and provides a glimpse into the visualization revolution. On the one hand, the articles describe techniques borrowed from the foundation fields. For example, Muraki’s “Volume Data and Wavelet Transforms” employs image processing techniques; Max, Crawfis, and Williams’ “Visualization for Climate Modeling” is based on computer graphics techniques; and Beshers and Feiner’s “AutoVisual: Rule-Based Design of Interactive Multivariate Visualizations” employs user interface and virtual reality concepts.

The articles also demonstrate how visualization is effectively being used in the application arena and how it supports breakthroughs in many of these applications, van Wijk’s “Flow Visualization with Surface-Particles” and Delmarcelle and Hesselink’s “Visualizing Second-Order Tensor Fields with Hyperstreamlines” report on applications in flow visualization. Max, Crawfis, and Williams discuss an application in climatology; Beshers and Feiner present a business application; and Muraki explains an application in medical imaging.

Finally, Wefer and Clifton’s “Direct Volume Display Devices” demonstrates how visualization might revolutionize one of the foundation fields, computer graphics. They survey true 3D volume display devices, which promise a commercially viable alternative to the 2D flat screens currently used for 3D display. This is an important fruit for the foundation fields to harvest from the seeds they provided.

References

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