Guest Editor’s Introduction

Computer Graphics in Medicine

Michael Rhodes
Toshiba America MRI

This issue features new applications of computer graphics that may help improve your health care. This self-interest helps explain why the anatomic presentations delivered by computer graphics in medicine have such a magnetic appeal and provoke such widespread interest among computer professionals and lay people alike. It is easy for us to understand the orientation and position of a brain tumor when we see it displayed within the context of a semi-transparent skull. These visual presentations invite wonder and exploration and spark our fascination at finally being able to see what is under our skin in an unrestricted, painless manner.

Three-dimensional anatomic views from Computed Tomography (CT) and Magnetic Resonance (MR) data have now caught the public’s attention. Having seen
The incubation period for new computer graphics techniques in medicine is generally long and arduous. The wait is particularly frustrating for computer graphic specialists, to whom the medical benefits appear self-evident. Why does it take so long to incorporate computer graphics applications into routine clinical medicine?

There are many reasons for these delays, but to some extent we have ourselves to blame. In the halcyon days of computed tomography, we computer graphic professionals created self-congratulatory illusions of our contribution to medicine. In our excitement, we applied technology that was well established in synthetic imaging to clinical data and created new, often breathtaking, pictures of anatomic structures. Unfortunately, in our fascination with the images themselves, we paid too little attention to their accuracy, medical merit, clinical utility, and our ability to extend this technology to the local community imaging center in a cost-effective manner.

This has been a hard lesson to learn. As the computational power of graphic engines steadily increases and graphic software produces ever more realistic synthetic presentations, we tend to become technically myopic. We race to harvest the next crop of technical innovations with little concern for their relevance to clinical practice. Such unbridled enthusiasm easily leads to mistakes. With hindsight, we can now see that clinically and commercially successful medical applications have emphasized image presentation tools that were clinically useful, decreased the cost of care, and replaced an expensive, medically more dangerous procedure.

Over the past five years, computer graphics in medicine has become much more sophisticated. We have learned to listen to our physician users and have focused more carefully on practical applications. Articles in this issue bear witness to this new maturity. For example, early “pretty pictures” produced by 3D graphics techniques were viewed with great suspicion and written off as gimmickry by the radiological community. 3D images were never used in any routine medical workup. This is no longer true. Remarkable strides have been made in the presentation of anatomic data in more lifelike, intuitive formats that meet the needs of clinicians. The dialogue between...
our two disciplines has become more commonplace and more productive, but much more dialogue is needed.

The combination of computer graphic and medical imaging knowledge is uncommon. Physicians suffer from a myopia similar to our own: they are ill-prepared to draw upon the technical solutions spawned from our efforts to clearly illustrate complex data. Knowing how and when to use measures of shading, transparency, and radiosity for the optimal visualization of data takes training that is rare even in our own ranks. Over time, however, our technology’s secret rites will become demystified as our dialogue with physicians improves.

Looking ahead to the 1990s, we can expect that three-dimensional presentations will be looked upon as rather mundane, uninspired radiological procedures. More important, routine use of computer graphics may eventually become a requisite part of medical exams, and their absence may become grounds for malpractice litigation.

Our goal should be to improve anatomic presentations in order to eliminate the ambiguous, equivocal interpretation of images. In this way physicians have greater confidence in diagnoses. Improved diagnostic confidence will make early therapy possible, which will further establish computer graphics as a boon to patient care.
There are many applications of computer graphics in medicine other than clinical imaging. Biochemists and other biomedical researchers made use of computer graphics well before the technology was applied to clinical medicine. They continue to push at the limits of computer graphics techniques in the visualization of molecular bonds and pharmaceutical design. Prostheses design and anatomic model manufacturing are also beneficiaries of computer visualizations. Such views have been used to model stress, optimize shape, increase strength, and even directly control the manufacturing process. Surgery planning using computed images and computer assistance to actual surgery is now common in both orthopaedic and neurosurgical procedures.

Your first prescription for computer graphics in medicine can be found in the five papers in this issue. Prescription "refills" will be supplied in additional papers on this topic in subsequent issues of Computer Graphics and Applications.

Thanks to all the authors for their contributions, and to the reviewers for their efforts. The solicitation, review, and author response for this issue were exceptionally fast, making it an excellent, timely snapshot of current work. My special thanks go to Linda Beller, our engineering secretary, for keeping us organized. All of us involved in this special issue share my enthusiasm for what we think is the most satisfying and potentially the most beneficial application of computer graphics.

Michael L. Rhodes is director, software engineering, at Toshiba America MRI, Inc., South San Francisco, California, where magnetic resonance scanners are developed and manufactured for the clinical marketplace. He was a co-founder of MPDI, Inc., a software and clinical imaging company specializing in diagnostic radiology, where he spent nine years as vice president of applied research and development. His interests include medical applications of computer graphics, computer communications, and development of software products for clinical imaging. In 1978-80 Rhodes was an assistant professor of computer science at UCLA.

Rhodes is a frequent lecturer and author of more than 70 papers in the field of medical computer graphics and image processing. He obtained his B.S. degree in aerospace engineering from the University of Michigan and his MS and PhD degrees in computer science from UCLA.

Rhodes is a member of the IEEE Computer Society, KSNIA, ACM, and Tau Beta Pi. He is co-chairman of the Computer Assisted Radiology (CAR) Conference Series, held in Berlin every two years since 1985.

Rhodes can be reached at Toshiba America MRI, Inc., 280 Utah Avenue South, San Francisco, CA 94080.

March 1990