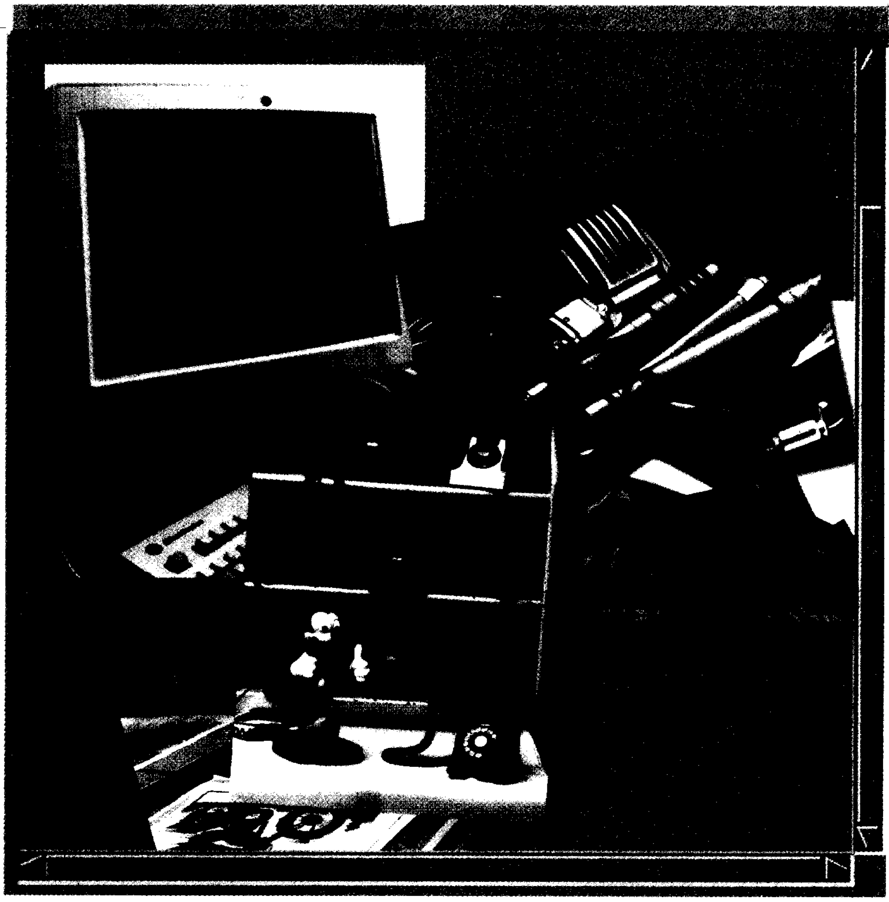
Guest Editors:

*Alok Choudhary,
University of Illinois,
Urbana-Champaign*

*Ian Foster,
Argonne National
Laboratory*

*Rick Stevens,
Argonne National
Laboratory*



Guest Editors' Introduction

Multimedia Applications and High-Performance Computing

Digitalization of traditionally analog data such as video and audio, and the feasibility of obtaining network bandwidths of gigabits per second or more, are two key advances that have made possible the realization of interactive distributed multimedia systems. Multimedia is normally perceived as combining text, video, audio, graphics and images in computers to provide information to users through a much richer interface.

The potential applications of multimedia systems span almost all domains for which computers have already proven useful, and seem likely to extend to many new domains as well. Examples of application domains include health care, education, command and control, entertainment, information systems, simulations in science and engineering, computer-aided design, and collaborative work. These applications will have far-reaching implications for diverse technologies, including personal computers, servers, networks, network management (and related software layers), operating systems, database systems, user interfaces, and authoring software.

Advanced multimedia systems depend on high-performance computing and communication technologies for the processing, storage, movement, and real-time delivery of data. For example, parallel computers with large attached storage are natural candidates for media servers because they can provide the compute, storage, and communication rates required to store, manipulate, retrieve and schedule data for large numbers of users, while satisfying real-time requirements and providing high reliability and availability. Similarly, future immersive virtual reality interfaces will require computing and communication capabilities superior to today's supercomputers. In both cases, high-performance systems originally designed for traditional science and engineering applications are being adapted to meet new requirements. Multimedia systems can also benefit traditional high-performance computing applications by enabling richer forms of user interaction. For example, future scientific or engineering simulation systems will likely permit the use of voice and gestures to steer the simulation, provide users with interactive multimedia help facilities, and use virtual reality techniques to immerse users in simulation results.

The five articles in this special issue provide an introduction to the many interesting issues that arise at the intersection of multimedia and high-performance computing. The first two articles describe the application of advanced interface techniques to two very different high-performance computing problems: the management of broad-band networks and collaborative science. The other three articles describe developments in software and hardware architecture that are intended to advance various multimedia applications.

The article, "Management of Broad-band Networks using a 3D Virtual World" by Crutcher et al., examines the application of multimedia techniques to the challenging problem of managing high-speed networks. (These networks are in turn used for multimedia applications.) This work tackles the fundamental problem of observability and controllability of broad-band networks. A virtual world provides a network management interface through which a user can observe and interact with the network directly in real-time. It also serves as a platform to experiment with many aspects of network transport, control and management techniques.

The article, "Designing the Future" by Disz et al., provides an introduction to the work of the Futures Lab at Argonne National Laboratory. The Futures Lab is pursuing various projects intended to support collaborative science: that is, the use of high-performance computing, networking, and display technologies to create virtual environments in which remote researchers can collaborate on challenging problems in science and engineering. A centerpiece of the lab is the CAVE, a high-end, immersive virtual reality environment developed at the Electronic Visualization Laboratory at the University of Illinois. Coupling the CAVE with a parallel supercomputer has allowed some exciting experiments in computational steering.

The article, "DAVE: A Plug-and-Play Model for Distributed Multimedia Application Development" by Friesen et al., describes an enabling technology for high-performance multimedia applications: an environment that supports the development of multimedia applications for collaborative engineering (for example, desktop video conferencing). DAVE uses object-oriented techniques to achieve device and media extensibility, and provides easy access for application developers who do not wish to learn the details of the media devices or who want to dynamically change their applications at runtime. DAVE's application program interface provides support for real-time as well as other services.

The article, "Design Issues in High-Performance Media-on-Demand Servers" by Jadav et al., addresses issues that arise when high-performance computers are used as media servers. The article outlines a probable scenario for multimedia services, and based on this scenario, identifies the requirements for the server architecture. Given that media servers need to store and retrieve massive amounts of data, efficient input-output of data is one of the most important considerations, especially to satisfy real-time delivery requirements for video data. Furthermore, a server must provide a high degree of reliability, availability, and fault tolerance, and at the same time must be cost-effective. The article also presents performance data that illustrate the tradeoffs in choosing different design parameters and configurations.

Finally, "The Magic Video-on-Demand Server and Real-time Simulation System" by Taylor et al., describes a specific implementation of the media server concept. It describes the design and implementation of a video-on-demand server developed at the Sarnoff Real Time Corporation. The Magic system is intended both as a real-time video processor and for sourcing video streams to clients. The real-time video processor permits video capture, compression, encoding and processing. The Magic system is based on a massively parallel architecture with scalable I/O bandwidth.

Readers interested in learning more about research and development in multimedia technology as well as applications can read the following publications. *IEEE Multimedia* is a technical magazine, published by the IEEE Computer Society. It contains papers describing new results, tutorial papers, information on applications, and information on new products. *Multimedia Systems* is a joint publication of ACM and Springer-Verlag and contains technical articles and other information. In addition, there are two main conferences on multimedia. The IEEE International Conference on Multimedia Computing and Systems (ICMCS) will next be held in Hiroshima, Japan, June 17-21, 1996, while the ACM Multimedia Conference will be held in San Francisco, November 6–11, 1995. In addition to these meetings, there are many others on topics (such as compression) that are directly applicable to multimedia systems.

Ian Foster is a scientist in the Mathematics and Computer Science Division of Argonne National Laboratory, where he conducts research on languages, software tools, and applications of parallel computers. His most recent book, *Designing and Building Parallel Programs*, was published by Addision-Wesley in the fall of 1994, and is also accessible via World Wide Web at URL http://www.mcs.anl.gov/dbpp. Foster received his PhD from Imperial College in computer science in 1988. He can be reached at the Mathematics and Computer Science Division, Argonne National Laboratory, Argonne, IL 60439; itf@mcs.anl.gov.

Alok Choudhary's biography can be found on page 39.

Rick Stevens' biography can be found on page 21.