Simulation on Demand Technologies and Demonstrations

SUMMARY

We will implement a Grand Challenge tornado prediction model on HPCC systems and deliver the simulation results on−demand over NYNET. In a second simulation on−demand demonstration, we will link rendered digital terrain models with Landsat coverage, and related spatial databases to produce an interactive, multimedia, 3D Geographic Information System (GIS) for use over NYNET. We will port state of the art rendering software, navigation software, and simulation models into an HPCC environment. The results of the simulations on−demand will be accessible over NYNET through a sophisticated network−based user interface Mosaic software which we will enhance to include virtual reality capabilities.

PARTICIPANTS

Syracuse University (NPAC, Computer Engineering, Computer Science, School of Information Studies, School of Education), AGE, NYNEX, Digital, Maspar, IBM, Thinking Machines, Jet Propulsion Laboratory, ULTRA Corporation, University of Oklahoma

KEY CONTACTS

Geoffrey Fox, gcf@npac.syr.edu, (315) 443−2163
Kim Mills, kim@npac.syr.edu, (315) 443−4686

IMPACT

Network delivery of the results of interactive simulations with links to multimedia databases will have direct application in education, tourism, and economic development, as well as related dual−use defense applications. This demonstration will serve as an example for future "simulation on demand" products for the home and school markets with networks such as NYNET providing the essential link between High Performance Distributed Computing (HPDC) facilities and end users in school districts, local government, and the community.

DESCRIPTION

Grand Challenge Scientific Simulation On−Demand

We will develop a real−time, interactive tornado model based on an ongoing collaboration with the Center for Analysis and Prediction of Storms (CAPS) at the University of Oklahoma. NPAC has written parallel versions of this Grand Challenge tornado simulation model to run on a number of high−performance computing systems. This state of the art, severe weather simulation model will be incorporated into an AVS based graphic user interface to provide three dimensional rendering and interactive model control. More sophisticated VR based interfaces to the model environment will be developed through our collaboration with AGE to develop high−performance edutainment applications.

As the research model for a prototype operational severe weather forecast system the CAPS modeling system is unique in that it was developed from scratch to run on massively parallel processing systems. The NPAC collaboration with CAPS is one of several collaborative efforts with leading computational research centers around the nation. The CAPS model is highly regarded in the meteorological community and is well suited to the educational applications we propose here. Running in an HPDC environment and accessible over NYNET, the CAPS model presents a unique opportunity for use in the classroom. The CAPS model will be made accessible to students and teachers who interactively control the simulation, modify laws of physics, and see simulation results in real−time. This is part of "The Living Textbook Project: Interactive Learning on the Information Highway" involving Syracuse University School of Education, Columbia University Teachers College, and NYNEX.

Three−Dimensional Geographic Information System On−Demand

In a second simulation on−demand application, we will implement terrain rendering and visualization software developed by the NASA Jet Propulsion Laboratory to create an interactive, 3D GIS of New

York State. This software system was successfully used to create "Los Angeles – the Movie", and "Mars–the Movie." We will create an equivalent product in 'New York State – The Interactive Journey."

The basis of this simulation is a digital terrain model overlayed with Landsat coverage data and links to related, spatially cued multimedia databases. The rendering requirements for creating a real–time, interactive journey of New York State are exceptionally demanding in terms of computational resources. We will implement an existing sequential renderer in an HPDC environment to take advantage of NPAC and Cornell's massively parallel processing facilities. InfoMall's technology wing, InfoTech, is ideally suited to provide access to the leading algorithm research efforts in this area.

NYNET delivery of the results of this interactive, 3D GIS with links to multimedia databases will have direct application in education, tourism, and economic development as well as related dual–use defense applications

Information Science Issues of Linked, Multimedia Databases

We believe that this demonstration project will be an example for future "simulations on demand" products for the home and school markets with networks such as NYNET providing the essential link between HPDC facilities and end users in school districts, local government and the community. From an information science perspective, our focus will be to concentrate on the enabling technologies required to construct an interactive, simulation on–demand demonstrations with links to related text, image and other data formats.

Simulation on–demand requires support in the information system for an active role by the user, and hence support for a combination of searching and navigation capabilities. Supporting an active role by users in an information system requires more than merely connecting static data with animation – the underlying data layers will vary depending on user needs. We must capture in information space, and build into the system, a capability for dynamically understanding where the user is coming from and going to.

Combining searching and navigation capabilities defines a second area of inquiry. Searching is based on user input, where the system then carries out a related action. For example, if a user selects "Syracuse" while navigating in New York State, the system could generate a menu listing types of available information. For example if the user selected historical development, the system would be designed to locate the best place for further browsing or searching or retrieving specific pieces of information such as historical maps, or industry, transportation, and demographic information.

Searching gives the user freedom to select data and information in an intuitive way for user understanding; this format is not necessarily text (e.g., business or statistical data in a graph form). The data sets underlying the journey are not static and we must present options to the user.

Navigation is user directed action and occurs both within 3D GIS and related databases. ln the familiar hypercard type of application, the user can easily become lost. Navigation provides for a user's sense of direction to support exploration of the data environment, and must take into account how to best organize data to match predicted user behaviors, as well as presentation and visualization issues.

Northeast Parallel Architectures Center, Syracuse University, npac@npac.syr.edu