

Distributed Interactive and Real-Time Simulations

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1 Distributed Interactive Simulation

In the early days of computer simulation, *interactive* simulation was a term much favored by analog computer manufacturers wishing to emphasize the advantages of their products over digital computers. Analog computers do, in fact, provide a commendable degree of user interaction, especially at run time, and offer many lessons for the designers of interactive digital simulation systems. With Digital systems, on the other hand, the development of interactive simulation facilities has taken many years to gather momentum.

However, with the increase in the available processing power, the prospects for interactive simulation have been dramatically changed. Indeed, computer interactive simulation is currently undergoing an explosion of innovation and a dramatic increase in its range of applications, that today no one would think of designing any complex system (an aircraft, a defense strategy, training of complex systems in science and engineering, entertainment, emergencing planning to prepare for earthquakes and other disasters) without creating its simulation first. But simulation is also notoriously expensive. As a result of this, distributed interactive simulation, in which the distributed environment could be both in terms of memory and geographical locations, seems to be a promising solution.

Distributed Interactive Simulation (DIS) provides an infrastructure to build large scale-simulations for the simulation of highly interactive activities by interconnecting several types of simulators via a network. This new technology has brought a new set of issues and challenging problems to solve.

The new tools of DIS are able to support substantially the solution of highly complex problems of mathematical modelling in physics, engineering, and biology, just to mention a few. This is an important direction of DIS technology applications.

Distributed Interactive Simulation is still in its infancy, and despite the fact that research in parallel and distributed simulation (PADS) has been going for some times, DIS and PADS communities have proceeded largely independently of one another. Because of this, techniques developed for one domain have not found applications in the other.

Complex interactive simulation such as war games and flight simulators are logically good candidates for distributed simulation, however interactive distributed simulation poses special problems to most existing

parallel and distributed simulation algorithms.

As we look towards the future, an important direction of research in distributed interactive simulation appears to lie in the design of tools and environment that facilitate the transfer of distributed interactive simulation to general simulation community, while extending their use in new real time application domains.

In the next meeting of this workshop, we hope to see more papers devoted to addressing these problems and in reporting challenging experiences in the use of this technology by a wider community.

2 Real Time Simulation

The real-time simulation covers a range of topics. It involves the communication of values of system variables between those parts of the system which are modeled on the computer and those parts which are external to the computer. The external equipments may include sub-systems modeled on other computers. The concept of communication interval, as used in many simulation languages, can be extended to cover the process of communication between different parts of such systems.

The major area of application of real-time simulation techniques has been to the design of training simulators. The most time critical of these applications occur in the aerospace field, particularly in military applications. In many of these applications, the integration process represents quite a small percentage of total execution time much of which is devoted to multiple variables function generation. Hence, there is a need to tackle these problems, in any attempt to include real-time features in a general interactive simulation facility.

Indeed, real-time simulation is necessarily interactive in some sense or other: if only to represent the output of the model directly to the user in a more realistic way. The incorporation of actual plan or human operator into a simulation usually calls for interactive real-time simulation. This process is most highly developed in virtual reality simulators, training simulators used to train civil and military aircraft pilots, power plant and process plant operators, (just to mention a few), in which the computer simulation accepts operator inputs from, and to drive instruments and other indicators on a realistic control panel. In many cases, the computer also produces realistic visual, sound and motion effects to heighten the illusion of reality.

The increasing computational complexity of simulating such systems has led researchers to conduct simulation studies on such platforms as multi-computer network architectures. As a result of this, the distributed interactive simulation (DIS) and real time systems, in which the distributed environment could be both in terms of memory and geographical locations, seems to be a promising solution.

3 Future Prospects for Distributed Interactive and Real Time Simulations

In spite of considerable advances in recent years in the development in distributed simulation and interactive computing resources, there is undoubtedly a need for new tools of DIS that would be able to support

substantially the solution of highly complex problems of mathematical modelling in physics, engineering, and biology, just to mention a few. This is an important direction of distributed interactive and real-time simulation technology applications.

The collections of papers included in this proceedings were selected for presentation at the first International Workshop on Distributed Interactive Simulation and Real-Time Applications, it is our belief that this will be the focus of much interest in the coming years. We hope the workshop and its proceedings continue to serve the purpose of bringing together a diverse group of scientists and engineers in pursuit of efficient ways to harness the power of parallel machines and in contributing to the cause of efficient applied distributed interactive simulations.

We hope in the next meeting, we will see more papers addressing these issues which are very important to advance the technology.

References

- [Bouk97] Boukerche, A., and Sajal Das., "Distributed Interactive and Real-Time Simulations" *Technical-Report*. In preparation, 1997.
- [Fish94] Fishwick P., "Simulation Model Design and Execution: Building Digital Worlds", *McGraw Hill*, 1994.
- [Fuji90] Fujimoto, R. M., "Parallel Discrete Event Simulation", *Communications of the ACM*, Vol. 33, No. 10, Oct. 1990, pp. 30-53.
- [Hay78] Hay, J. L., "Interactive Simulation on Minicomputers Pt1, ISIS a CSSL Language", *Simulation*, July 1978, pp. 1-7.
- [VanH94] VanHook, D. J., Calvin, J. O., and Fusco, D., "An Approach to DIS Scalability", *11th Workshop on Standard for Interoperability of Distributed Simulation*, Vol. 2, 1994, pp. 347-356.