

## Educational Extensions of Large-Scale Simulations Enabled by High Performance Computing

**Dan M. Davis**  
Information Sciences Institute, USC  
Marina del Rey, California  
[ddavis@isi.edu](mailto:ddavis@isi.edu)

**Laurel K. Davis**  
Apple Tree Services  
Culver City, California  
[laurel.davis@appletreeservices.com](mailto:laurel.davis@appletreeservices.com)

### ABSTRACT

Large-scale intelligent agent simulations, enabled by high performance computing (HPC), have been effectively used by the Department of Defense for experimentation and analysis. The authors analyze their experiences in these and related areas, then present data and conclusions to support new applications of proven pedagogies to broaden the value of these capabilities across the areas of training and education. Over more than a decade, HPC has shown the ability to enable otherwise unattainable sizes of intelligent agent simulations, growing from small unit, to battlefield, to theater of war, and, finally, to global-scale operations. The techniques necessary to achieve these levels were imported and adapted from early supercomputing research in basic science projects at major universities. Among the insights from that research were the reductions of validity and utility suffered when constrained samples of the subject phenomena were simulated. This paper extends that concept into the discipline of education and demonstrates the putative desirability of having large-scale capabilities in the educational environment as well. The authors describe the available technologies for large-scale simulations, review the successes of experimentation and analysis enabled by those technologies, and outline the many opportunities for implementation in education. They then focus on early experimentation using distributed HPC to aid in technical and non-technical education for all age cohorts. They lay out a roadmap for future development and for assessments of applicability of their techniques by others who should benefit from such capabilities. Cost/benefit analyses are invoked to assist the potential users in making valid evaluations of the applicability of these proven techniques to their own uses. The development of an interactive educational module is outlined, described and lessons learned are reported. A test on a trans-continental meta-computing platform will be reported from the viewpoint of both HPC performance and educational efficacy.

### ABOUT THE AUTHORS

**Dan M. Davis** is the Director, JESPP Project, Information Sciences Institute (ISI), University of Southern California, and has been active in large-scale distributed simulations for the DoD. While he was the Assistant Director of the Center for Advanced Computing Research at Caltech, he managed Synthetic Forces Express, a major simulation project. Prior to that, he was a Software Engineer on the All Source Analysis System project at the Jet Propulsion Laboratory and worked on a classified project at Martin Marietta, Denver. An active duty Marine Cryptologist, he recently retired as a Commander, USNR, Cryptologic Specialty. He has served as the Chairman of the Coalition of Academic Supercomputing Centers and the Coalition for Academic Scientific Computation. He was part of the University of Hawai'i team that won the Maui High Performance Computing Center contract 2001. He received a B.A. and a J.D., both from the University of Colorado in Boulder.

**Laurel K. Davis** is the Director of Apple Tree Services, an independent educational consulting and research organization in Culver City, California. She is an experienced classroom educator who has served in several public schools in the Los Angeles basin. Her current activities include teacher training for both public and private schools, consulting with parents about the transition of their children from elementary into middle school environments, creation of educational materials to address non-academic skills and techniques to facilitate and enable scholarly pursuits, and leadership training and assessment. She has additional experience in commercial and private settings as a programmer and web site designer/manager. She received a B.A. in Communications and a M.Ed., both from the University of California, Los Angeles.