

A GPU-Enhanced Cluster for Accelerated FMS

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ABSTRACT

The Forces Modeling and Simulation (FMS) community has often been hampered by constraints in computing: not enough resolution, not enough entities, not enough behavioral variants. Higher performance computers can ameliorate those constraints. The use of Linux Clusters is one path to higher performance; the use of Graphics Processing Units (GPU) as accelerators is another. Merging the two paths holds even more promise. There was successful proposal to the High Performance Computing Modernization Program (HPCMP) for a new 512 CPU (1024 core), GPU-enhanced Linux Cluster for the Joint Forces Command's Joint Experimentation Directorate (J9). The basic concepts underlying the use of GPUs as accelerators for intelligent agent, entity-level simulations are laid out. The simulation needs of J9, the direction from HPCMP and the careful analysis of the intersection of these are explicitly discussed. The configuration of the cluster and the assumptions that led to the conclusion that GPUs might increase performance by a factor of two are carefully documented. The paper will then report in detail about the execution of the actual installation and implementation of the JSAF simulation on the cluster. Issues, problems and solutions will all be reported objectively, as guides to the FMS community and as confirmation or rejection of early assumptions. Lessons learned and recommendations will be set out in detail. Early characterization runs of a single CPU with GPU-enhanced extensions will be reported.

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. He was a lead in the proposal to take over the Maui High Performance Computing Center, where he subsequently served as the Director of Finance and Contracts. 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 received a B.A. and a J.D., both from the University of Colorado in Boulder.

Robert F. Lucas is the Director of the Computational Sciences Division of the University of Southern California's Information Sciences Institute (ISI). There he manages research in computer architecture, VLSI, compilers and other software tools. He has been the principal investigator on the JESPP project since its inception in 2002. Prior to joining ISI, he was the Head of the High Performance Computing Research Department for the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory, the Deputy Director of DARPA's Information Technology Office, and a member of the research staff of the Institute for Defense Analysis's Center for Computing Sciences. From 1979 to 1984 he was a member of the Technical Staff of the Hughes Aircraft Company. Dr. Lucas received his BS, MS, and PhD degrees in Electrical Engineering from Stanford University in 1980, 1983, and 1988 respectively.