Application of Proven Parallel Programming Algorithmic Design to the Aggregation/De-aggregation Problem

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ABSTRACT

A continuing problem in entity-level, intelligent agent simulations has been one of efficiently, effectively and expediently aggregating smaller units like squads and platoons into larger ones like companies and battalions and then de-aggregating them again at appropriate times. This paper reviews the goals and issues of the aggregation/de-aggregation (A/DA) problem and then lays out some solutions based on High Performance Computing, computational science and lessons learned from advanced techniques, such as adaptive simulation meshes. Experience has shown and logic dictates that aggregation is a more straightforward operation than is de-aggregation. A/DA of collective units is required for future, large-scale simulations, *e.g.* Sentient World Simulation. Understanding how to distribute the smaller units and how to represent the impacts of the simulation on these segments has largely eluded the M&S community for years. This problem is made more complex by the existence of significant amounts of "legacy code" and this paper gives examples of a successful approach to working with such code in an HPC environment. Three workable solutions are enabled by HPC: simulating all levels continuously while displaying only the designated unit level, simulating smaller entities' behavior with reduced behavioral resolution to save compute resources, and foregoing all lower level simulation by simulating only the top-level designated. This last method requires laying down the lower-level entities using doctrine, status, and terrain to achieve realistic disposition. This paper will investigate the processes, impacts, and performance of all three methods. Entity migration across various compute nodes in cluster computers and germane HPC examples from similar computational approaches will be described. The approach applies methods, shown to be effective in on-going research in the physical sciences, to problems facing the DoD M&S community. Performance analyses are anticipated, as are user evaluations by operators, controllers, and analysts.

ABOUT THE AUTHORS

Thomas D. Gottschalk is a Member of the Professional Staff, a Senior Research Scientist at the Center for Advanced Computing Research (CACR), and Lecturer in Physics all at the California Institute of Technology. He has worked at CACR for nearly a decade advancing the use of massive parallel computers for simulation. His instructional duties include Statistics and Experimental Design for Caltech Physics Graduate students. Dr. Gottschalk has been active in parallel programming for nearly two decades, with efforts spanning integrated circuit design, intelligent agent simulations, theater missile defense, and physics modeling. He consults for a number of other organizations, including his work on space based systems for the Aerospace Corporation. He received a B.S. in Physics from Michigan State University and a Ph.D. in Theoretical Physics from the University of Wisconsin.