Multi-Abstraction Levels in HPC: Enabling Consistency, Integration and Validation

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ABSTRACT

DoD requirements for training, analysis and evaluation require simulation technologies that provide realism and consistency across multiple abstraction layers. Abstraction dimensions range from resolution of entities (soldiers to battalions) to models of behavior paradigms (combat forces doctrines to social conduct predispositions). Both everyday users and General Officer commanders report and decry the lack of adequate interaction among the humans in the loop, the simulated forces and the social-urban interaction components. One example of this failure in abstraction consistency is the much reported aggregation/de-aggregation problem, which is regularly held to be intractable. Multiple resolutions are essential in addressing current simulation needs. A single simulation addressing all entities at all levels of resolution is simply not feasible, independent of available resources. The issue is one of synchronizing the component simulations, preventing the significant inconsistencies among different resolutions. The authors have advanced a new approach to overcome this obstacle and they are embarked upon research into this and other potential solutions that would have a significant impact across all of the services and all multi-abstraction simulations. The ultimate goal is the provision of "platform portable" technology to ensure realistic consistency between abstraction layers. Preliminary research is implementing proof of concept demonstrations via a simulation scenario, using a reduced set of parameters, driving an exemplar of forces simulation, *e.g*. the Corps Battlefield Simulator and a social modeling program, the Joint NonKinetic Effects Model. The authors lay out their view of the need, the problem, and the research plan. They discuss the choice of programs and compute platform for the experiments and present an overview of the architecture developed. Early results of the tests and implications of these results on integration and validation are advanced. They conclude by discussing future research requirements and architectural issues lying at the heart of more general, valid multi-resolution simulation procedures.

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 more than 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 twenty years, 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.

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