Data Visualization and Large-Scale Battlespace Simulations: Challenges, Opportunities and Emerging Technologies

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ABSTRACT

This paper examines the special data visualization needs and challenges presented by large-scale battlespace simulations. Within the last decade, intelligent agent simulations have been enabled by high-performance computing to reach levels exceeding ten million entities (individual personnel, vehicles, weapons systems, etc.). These large-scale simulations create incredibly large sets of data in very short periods of time. Managing this data is a field of research of its own, but optimally exploiting this flood of data is even more challenging. The authors assert that, while the high-performance computers have created this problem, newly developed capabilities utilizing these same capabilities can and should be implemented to assure the warfighters are given the information they need most, when they need it, and in a form that will have the best chance of producing the correct outcome. This is based on their experience in visualization, high-performance computing, large-scale simulations, and military operations both in academic research and active duty military service or intelligence analysis. The paper recounts and alludes to historical examples of the difficulties in effectively conveying information within the chain of command, supporting the notion that these problems are neither unique to simulation nor are they issues that can be ignored, especially when solutions are at hand. Special emphasis will be put on new ways to convey the range of alternatives and communicate the relative likelihood of the predictions of future conditions, dispositions and actions, all without swamping the users with too much data. A survey of associated topics like causal modeling and behavioral science insights will also be presented along with analysis as to their contribution to better exploitability of the computer-generated insights. The paper concludes with recommended approaches for studying, evaluating and implementing the most promising techniques and technologies.

ABOUT THE AUTHORS

Philip Amburn is an Adjunct Lecturer in the Computer Science Department of the University of Arizona. Prior to that, he was a Research Assistant Professor at Mississippi State University and also had served as an Adjunct Faculty member at the Air Force Institute of Technology (AFIT). After AFIT, he worked at Wright-Patterson AFB in Ohio for SAIC as the Forces Modeling and Simulation on-site advisor in Programming Environment and Training for the High Performance Computing Modernization Program. His research interests are constructive and virtual simulation, interactive 3D graphics, and visualization. He retired as a Lieutenant Colonel from the United States Air Force. Dr. Amburn received a BS degree in Physics from Kansas State Teachers College, his MSCS degree from AFIT, and his Ph.D. degree in Computer Science from the University of North Carolina, Chapel Hill.

Dan M. Davis is a consultant for the Information Sciences Institute, University of Southern California, focusing on large-scale distributed DoD simulations. His service there was capped by his being the Director of the JESPP project for a decade. Earlier, as Assistant Director of the Center for Advanced Computing Research at Caltech, he managed Synthetic Forces Express, bringing HPC to DoD simulations. Prior experience includes serving as a Director at the Maui High Performance Computing Center and as a Software Engineer at the Jet Propulsion Laboratory and Martin Marietta. He has served as the Chairman of the Coalition of Academic Supercomputing Centers and has taught at the undergraduate and graduate levels. As early as 1971, Dan was writing programs in FORTRAN on one of Seymour Cray's CDC 6500's. He saw duty in Vietnam as a USMC Cryptologist and retired as a Commander, Cryptologic Specialty, U.S.N.R. He received B.A. and J.D. degrees from the University of Colorado in Boulder.

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