IMPACT DRIVEN RESEARCH: EVALUATING AND IMPROVING THE DE FACTO STANDARD FOR PARALLEL PARTICLE ADVECTION

Foundational visualization algorithms are central to the production of visualization tools running at computing centers around the world but consume tremendous amounts of limited resources. We believe that understanding the performance characteristics of these algorithms is critical in being good stewards of those unique resources. In this project, we investigate the foundational algorithm for parallel particle advection by focusing on a parameter sweep of the de facto standard algorithm "Parallelize Over Data" (POD). Our work has led to several discoveries: a glaring and resolvable "Parallelize Over Data" (POD) issue in poor default values, identification of the best choices of parameters for future tests, and the existence of viable testing alternatives that save time and resources. Our work sets forth a framework for applying solutions to a practical and often overlooked area in computer visualization.

METHODS & RESULTS

We performed an extensive parameter sweep of the POD algorithm using the implementation found in VisIt along with an updated version that performs communication asynchronously. We developed a framework that manages generating and executing arbitrary test configurations of parameter settings and performed tests on multiple datasets (see Figure). To aid in our analysis, we developed an imbalance metric to help unify comparability and created new visual metaphors for viewing the multiple axes of the study.

Next, we found that optimal configurations are not the widely used default, and, in fact, we find that the default configurations to be quite poor. Second, we find that it is not only possible to predict proper configurations, but that the same configuration is likely applicable in both the asynchronous and synchronous versions of the algorithms. On any given architecture we expect that the default configuration may not be optimal, but through testing, this is correctable and an updated system-specific default will save computing resources. Furthermore, resources may be saved by testing, given that asynchronous tests are the only ones needed. Additional analyses made possible through the imbalance metric has allowed us to further pinpoint additional parameters to ignore in future testing. Moreover, we have also identified areas for directed future analysis.

NEXT GENERATION WORK

We want to bridge the gap between the state-of-the-art and the state-of-the-practice for all foundational visualization algorithms. Furthermore, we hope to promote the efficient use of world-class computing facilities through evangelizing such a practical, yet impactful research paradigm.

PUBLICATIONS AND DATA SETS