Massive Remote Batch Visualizations (MRBV) Using AVS/Express Enabled by HECToR dCSE Team

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HPC experts from Research Computing Services at the University of Manchester, working under NAG's Computational Science and Engineering (CSE) support service for HECToR, the UK's national academic supercomputing facility, have ported the AVS/Express Distributed Data Renderer (DDR) visualization application to HECToR's Cray XT4. This enables researchers to perform visualization of datasets that are too large for local GPU hardware.

AVS/Express DDR provides parallel module processing, where various visualization techniques are applied to domain decomposed data. Parallel rendering and image compositing, utilizing the distributed memory on HECToR, allows significantly larger datasets to be visualized. The initial users are materials scientists that wish to examine (large) volume datasets acquired through CT X-Ray scanning techniques.

Commenting on the dCSE project success, Martin Turner (the Principal Investigator) said "*The MRBV project has allowed us to run our visualization code on much larger problem sizes than have been possible on any of our existing visualization hardware. In particular we are able to visualize a 350Gb volume. It has also allowed us to verify the approach taken in developing the parallel AVS code. Prior to running on HECToR, the product had only been tested on small scale clusters (32 cores). While certain architectural changes within the software were needed to run the code on HECToR, it is useful to see the code scaling to 1024 cores.*"

HECToR

HECToR is managed by EPSRC on behalf of the participating Research Councils with a mission to support capability science and engineering in UK academia. The Cray XT supercomputers, located at the University of Edinburgh, are managed by UoE HPCx Ltd. The CSE Support Service is provided by NAG Ltd and ensures users have access to appropriate HPC expertise to effectively exploit advanced supercomputers for their science. A critical feature of the CSE Support Service is the distributed CSE (dCSE) programme which, through lightweight peer review, delivers dedicated performance and scalability projects on specific codes in response to proposals from users. The dCSE programme now consists of over 50 focused projects complementing the traditional HPC user applications support and training also provided by NAG.

The dCSE projects completed so far have delivered outstanding examples of the cost savings and new science that can be enabled through dedicated CSE effort. The MRBV project reported here adds to these success stories with a successful performance improvement.

Project Background

The main goal of this dCSE project was to port AVS/Express DDR to the Cray XT4 hardware provided by HECToR (Phase2a). This will allow the visualization of large datasets that currently exceed the capabilities of GPU-based local visualization systems. The visualization of large datasets has long been a bottleneck in applications where validation of data acquired from scientific equipment is required at an early stage. Such validation would allow correctness of methods (such as the set-up of a physical experiment) to be determined prior to further computational or imaging-machine resources being spent. The initial users of the HECToR port will be Materials Science researchers from the University of Manchester, using datasets that are typically 50-500GB in size acquired by CT scanning equipment.

Martin Turner of the University of Manchester was the Principal Investigator on the project. George Leaver of the University of Manchester carried out the 12 person-month project in collaboration with the NAG CSE team and the AVS/Express DDR developers.

Project Results

The project developed a replacement MPI library for the AVS/Express user interface code, allowing it to forward MPI function calls from a login node (on which the User Interface code must execute) through a proxy running on a back end node and enabling the existing AVS parallel module architecture to be used for module development without the need to introduce another communication API. Custom AVS applications can then be developed where a user interface is required for interactive use. A parallel image compositing method using MPI has been implemented to replace the sockets-based code in AVS/Express. In addition, improvements to the AVS rendering code now allow interactive use of the application with many more processors than any previous installation of the product. Volumes of sizes up to approximately 7000x7000x7000 have been rendered.

A paper has been provisionally accepted, subject to corrections, for the Special Issue of e-Science AHM meeting 2010, in the Philosophical Transactions A of the Royal Society that describes the important components of the project.
Other publications are available at: http://wiki.rcs.manchester.ac.uk/community/mrbv

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A full technical report can be found at http://www.hector.ac.uk/cse/distributedcse/reports/

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