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Tomviz, ParaView, and VTK: Open, Scalable Visualization and Data Analysis for Tomographic Data

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Materials tomography involves a number of steps to go from projection images taken on the instrument to an aligned, reconstructed 3D volume. The Tomviz project builds upon a number of open source frameworks to deliver a powerful desktop application for research, leveraging the Python environment along with a number of scientific Python modules to deliver a comprehensive solution for materials tomography at nanoscale to atomic resolution. The development of the application will be discussed, along with the Python-based data processing pipeline, and the XML format used to enable complex, reproducible data processing, segmentation, and visualization pipelines. The application is based on Qt, VTK, ParaView, and ITK with a bundled Python distribution making use of NumPy, SciPy, and Python wrapped ITK/ParaView to offer a powerful visualization and data analysis application.

In addition new challenges are emerging as supercomputer architectures become more diverse, and complex. The addition of GPGPU, many-core CPUs, burst buffers and in-situ analysis/visualization lead to the increased need for closer integration of the data analysis and visualization pipeline with simulation codes. Computational power is outstripping I/O bandwidth as we move towards exascale computing, and the importance of in situ processing coupled with strategies for performing processing in burst buffers is more pronounced.

Summary

At Kitware we are working on a number of highly scalable, open source HPC solutions for data analysis and visualization. Well known projects such as ParaView and Catalyst offer solutions for post-processing, and in situ visualization. VTK-m offers a platform where scientists can develop a computational kernel once, and the framework will deploy this as a TBB, OpenMP or CUDA kernel. Tomviz offers an intuitive open source application to create a compelling tomography application aimed at experimentalists. As we move forward it is critical that simulation developers and experimentalists engage with visualization and data analysis teams as they develop codes for next generation architectures in order to fully reap the rewards of these systems, by more deeply engaging as data formats, movement, and reconstruction algorithms are designed, developed and deployed.

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