SDAV Support to Combustion Research with Visualization, Analysis, and Data Movements

N. Podhorszki (ORNL), S. Klasky (ORNL), H. Abbasi (ORNL), M. Parashar (Rutgers U.), Q. Liu (ORNL), J. Bennett (Sandia) P-T Bremer (LLNL), A. Gyulassy (Utah), R. Grout (NREL), F. Zhang (Rutgers.Univ), V. Pascucci (Utah), H. Kolla (Sandia), H. Yu (U. Nebraska), J. Chen (Sandia)

SDAV Scalable Data Management, Analysis, and Visualization

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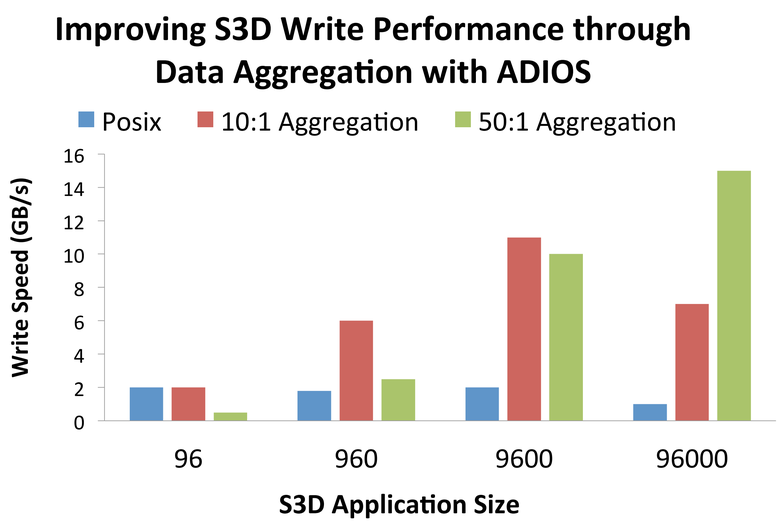
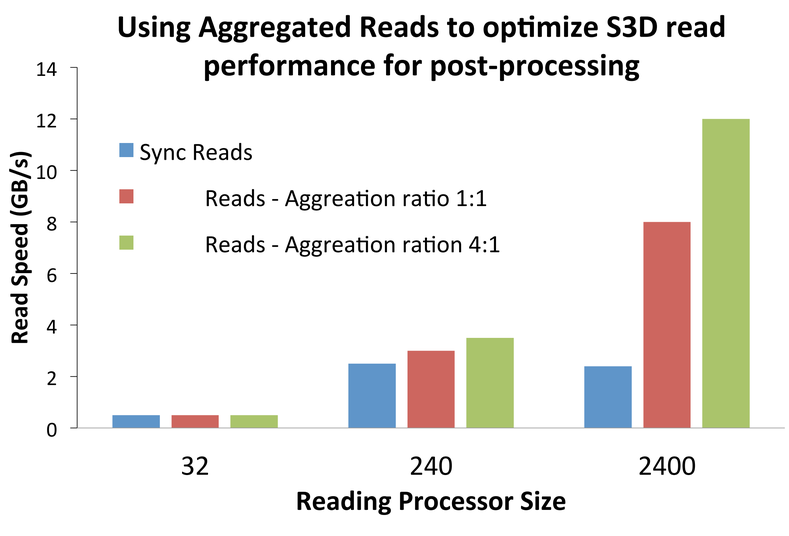
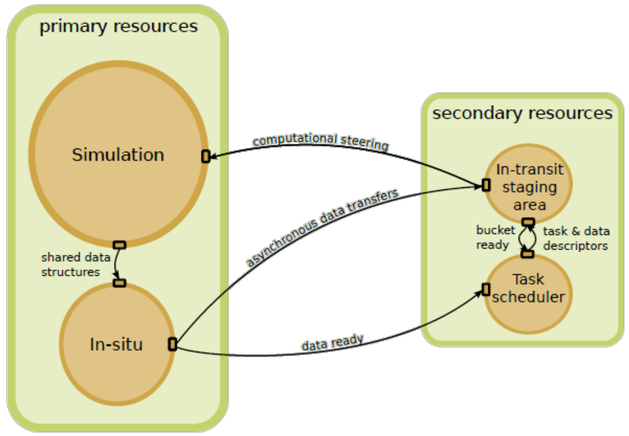
Large-scale I/O with ADIOS



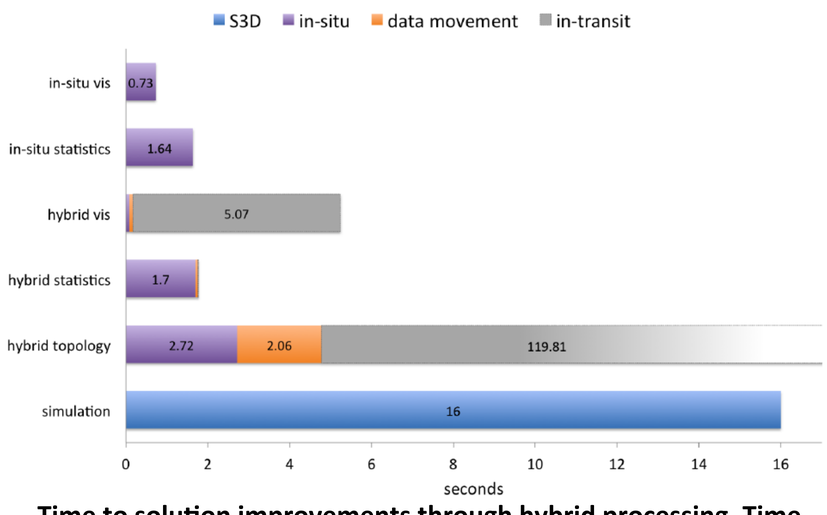
- ADIOS aggregation method provides very large performance improvements for write operations compared to standard POSIX approach
- Flexibility in selecting aggregation ratio can further improve performance
- Even better scalability can be achieved by threading metadata operations
- Similar method for read performance also dramatically improves read throughput



Combining In situ and In transit data processing



- Leverage resources where appropriate
- Manage in transit resources through staging area scheduling
- Combine in situ and in transit operations for optimizing time to solution
- Drastically reduce data movement through hybrid (in situ and in transit combined) analysis and visualization

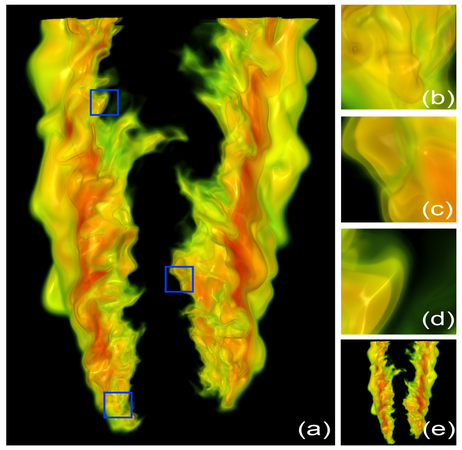


Time to solution improvements through hybrid processing. Time measured per simulation timestep at 4896 cores on OLCF Jaguar

- Exploit overlap with simulation to reduce impact of expensive computations
- Overlap multiple timesteps of analysis to prevent any blocking of the application
- Use in transit computation instead of application wide global communication

In situ and Adaptive Parallel Volume Rendering

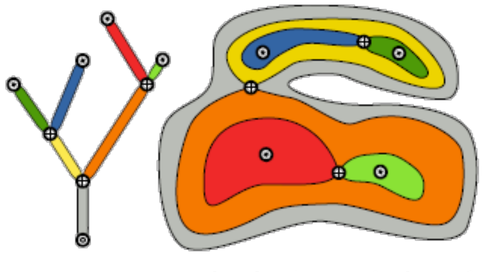
- Visualization of the hydroxyl radical variable of a combustion simulation data. (a) shows an overview of the data. (b) – (d) show three zoom-in views of the data
- In-situ high-resolution and high precision parallel rendered images allow clear observation of fine details in the large volume data set during the simulation time



- (e) shows the same view of (a) generated via an adaptive rendering. The approach performs rendering at a coarser-level data resolution adaptive to the image resolution, and can improve rendering performance while minimizing impact on visual results
- Utilize the decoupled nature of visualization and analysis algorithms to perform expensive operations without impacting simulation runtime

Hybrid Topological Analysis

- Combine two techniques to create a hybrid algorithm
- In situ local algorithm output with boundary data
- Streaming in transit portion performed in staging area
- Use resource scheduler to overlap the long computation cost of the in transit portion with simulation and with successive iterations of the analysis task
- Output data volume reduced from **98.5 GB** to **87.02 MB**



Merge trees represent merging in the evolution of contours as the isovalue is lowered through the range of function