Parallel Data Concatenation for Neutrino Event Analysis

Scientific Achievement

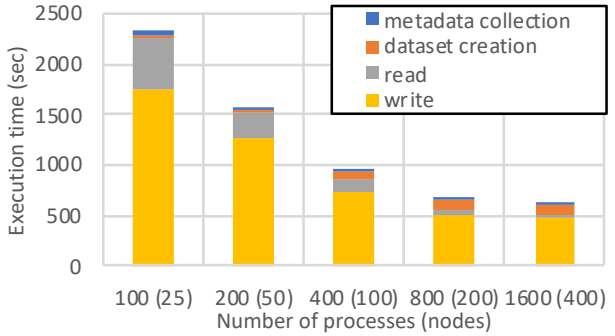
- **Develop scalable parallel I/O utility programs to concatenate large volume of HEP experimental data on DOE leadership HPC computers**

Significance and Impact

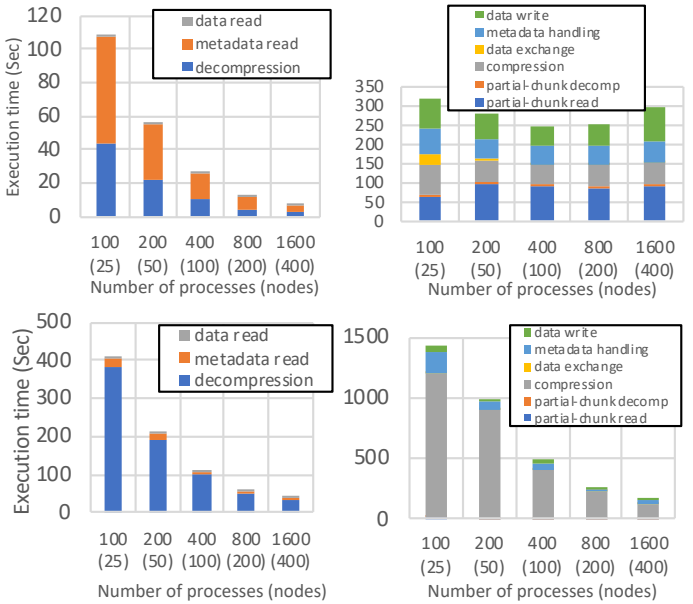
- **Concatenation of NOvA experimental data enables high degree of computational parallelism in event detection process**
- **Parallel data concatenation achieved scalable performance on Cori at NERSC**

Research Details

- **HDF5 feature settings tuning**
  - ***Adjust Metadata cache size*** to 128 MiB to reduce the number of metadata reads
  - ***Collective Metadata I/O mode*** to avoid data consistency check
  - ***In-memory I/O*** to speed up the metadata collection time
  - ***Adjust Data Chunk Size*** based on dataset sizes
  - ***Adjust data storage layouts*** based on dataset size to either COMPACT, CONTIGUOUS, or CHUNKED
- **Parallel I/O strategies**
  - Evenly distribute input files among all MPI processes
  - Options for independent and collective modes for reads and writes



Strong scaling performance for concatenating 6,400 FD files



Timing breakdown of 6400 FD files concatenation (left-top: 1D read, right-top: 1D write, left-bottom: 2D read, and right-bottom: 2D write)

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Future Works

- Add auxiliary datasets to be used for parallel read data partitioning
- Add utility tools to adjust HDF5 settings including chunk layout, compression, etc.

Action Items

- Study I/O patterns used by PandAna, a Neutrino experimental data analysis application
- Software delivery to be available publicly
- A case-study technical paper is under preparation