Development High-Performance Computing Capabilities for Non-Invasive Testing of Nuclear Weapons Systems

Principle Investigator: Curtis Ober, ccober@sandia.gov, (505) 844-1846, SNL/Org1442

Milestone Supported:
>   NA

Goal/Objective of CCC5:

>   The primary goal of this proposal is to support ASC Integrated Codes Project, Transformational Technologies, in its efforts to development high-performance computing capabilities for non-invasive testing of nuclear weapons systems and components (e.g., B61, W78 and W88) with an emphasis of applying these new capabilities to real data from actual nuclear weapons tests.

The determination of acoustic source signatures and material properties of internal components requires the solution of large-scale inversion problems (billions of unknowns) in an efficient and scalable fashion. Ichos/DGM is being used to investigate these inversion problems for recent and near future acoustic tests of NW systems and help determine source signatures, visco-elastic material properties, and even perform "design-of-experiment" optimizations to improve sensor placement. Given the size and resolution requirements for these real test environments, scaling studies will also need to be performed to demonstrate this capability at large scale. Scaling studies on Cielo will be used to identify any poor performance in the simulation and optimization algorithms, and will lead to software modifications to improve performance and scaling.

Scaling and Experience:

>   For a forward simulation, Ichos/DGM has been run up to 99,968 cores on a Cray XE6 achieving 68% parallel efficiency (86% parallel efficiency on 65,536 cores). For inversion runs, Ichos/DGM has been scaled up to 16,384 cores showing near perfect parallel efficiency, and is routinely run with ~6000 cores.

C1 Requirements: 2 jobs, 8518 nodes, 2 hrs each;
>   2 jobs, 8192 nodes, 2 hrs each;
>   2 jobs, 6144 nodes, 2 hrs each;

C2 Requirements: 4 jobs, 4096 nodes, 4 hrs each;
>   4 jobs, 3072 nodes, 4 hrs each

C3 Requirements: 8 jobs, 2048 nodes, 4 hrs each;
>   10 jobs, 1024 nodes, 8 hrs each;
>   20 jobs, 512 nodes, 16 hrs each

Total Cielo days required for this proposal: 2.53 days

Data Management:

How much data do you expect to store in the /scratch file system? 1 TB

How much data do you expect to store in the LANL HPSS archive? 1 TB
How much data do you expect to transfer across the WAN? 100 GB
For data to be transferred across the WAN: will it be destined for a file system, HPSS, or both? File system

Will your application require the use of the read-only "UDSL' file system? No

Application Codes and Application Development Teams

Please list the application codes that you will be running on Cielo during the CCC4 campaign. Ichos/DGM

Please list the primary contact for each application development/support team for the applications you plan to run. Ichos/DGM (Curtis Ober)

Visualization

What visualization software/tools will you require on Cielo? paraview

List of users authorized to use this CCC bank:
Curtis Ober, ccober@sandia.gov, (505) 844-1846
Bart van Bloemen Waanders, bartv@sandia.gov, (505) 284-6746