## nvprof and nvvp with mpi applications on Blue Waters (cuda or openacc)

Profiling cuda or OpenACC codes with nvprof requires some extra syntax on Blue Waters (and probably on other linux cluster instances).

The following was gleaned from : http://docs.nvidia.com/cuda/profiler-users-guide/index.html#mpi-nvprof , and https://bluewaters.ncsa.illinois.edu/ openacc-and-cuda-profiling.

- 1. Construct a wrapper that will be executed by mpirun/mpiexec/aprun or your local MPI launch mechanism a. aprun -N 1 -n 2 ./wrap.sh # for the example below
- 2. The wrapper should invoke nvprof with appropriate options and then start your MPI executable
- 3. Use Nvidia's nvvp (https://developer.nvidia.com/nvidia-visual-profiler) to analyse the resultant profiles.

This example was built on Blue Waters based on the PGI tutorial at: http://www.pgroup.com/lit/articles/insider/v4n1a3.htm

PrgEnv-pgi and cudatoolkit modules were loaded for the build and at runtime.

x arnoldg@h2ologin1:...cc/seismic\_openacc arnoldg@h2ologin1:~/openacc/seismic\_openacc> cat wrap.sh #!/bin/bash export LD\_LIBRARY\_PATH=\$CRAY\_CUDATOOLKIT\_DIR/lib64:\$LD\_LIBRARY\_PATH nvprof -o output.%h.%p.%q{ALPS\_APP\_PE} --profile-all-processes & sleep 1 `pwd`/gpu5o.out arnoldg@h2ologin1:~/openacc/seismic\_openacc> head -20 stdout.nvprof ======= Profiling all processes launched by user "arnoldg ======= Type "Ctrl-c" to exit ====== Profiling all processes launched by user "arnoldg"
====== Type "Ctrl-c" to exit
[PE\_0]: MPI rank order: Using default aprun rank ordering.
PE\_01: MPI rank order: 2 an article2222 [PE\_0]: rank 0 is on nid0922 [PE\_0]: rank 1 is on nid18515 ==15695== NVPROF is profiling process 15695, command: /mnt/a/u/staff/arnoldg/ope /seismic\_openacc/gpu5o.out ==12203== NVPROF is profiling process 12203, command: /mnt/a/u/staff/arnoldg/ope /seismic\_openacc/gpu5o.out 3D elastic finite-difference code in velocity and stress formulation with C-PML NX = 101 641 NY =NZ =128 NZ\_LOCAL = 64 2 NPROC = arnoldg@h2ologin1:~/openacc/seismic\_openacc> 🛽

After successfully generating the output files, the nvvp profiler is run from a login node (or a local machine if you have cudatoolkit installed and have copied the files):

arnoldg@h2ologin1:~/openacc/seismic\_openacc> nvvp output.nid09227.15695.0



Select a kernel from the table at right or from the timeline to enable kernel analysis. This analysis requires detailed profiling data, so your application will be run once to collect that data for the kernel if it is not already available.

Berform Additional Analysis

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You can collect additional information to help identify kernels with potential performance problems. After running this analysis, select any of the new re

Registers/Thread Shared Memory/Block 43 [ 2500 kernel instances ] seismic\_cpml\_3d\_iso\_mpi\_ac 0 B 42 [ 2500 kernel instances ] seismic coml 3d iso mpi ac Occupancy 22 [ 2500 kernel instances ] seismic\_cpml\_3d\_iso\_mpi\_ac Theoretical 25% 4 [ 2500 kernel instances ] seismic\_cpml\_3d\_iso\_mpi\_ac 1 [ 1 kernel instances ] seismic cpml 3d iso mpi acc 7 Shared Memory Requested 48 KiB Charad Mamary Evanutad 40 KiD