**GPU Solutions for PSCAD: IT17112**

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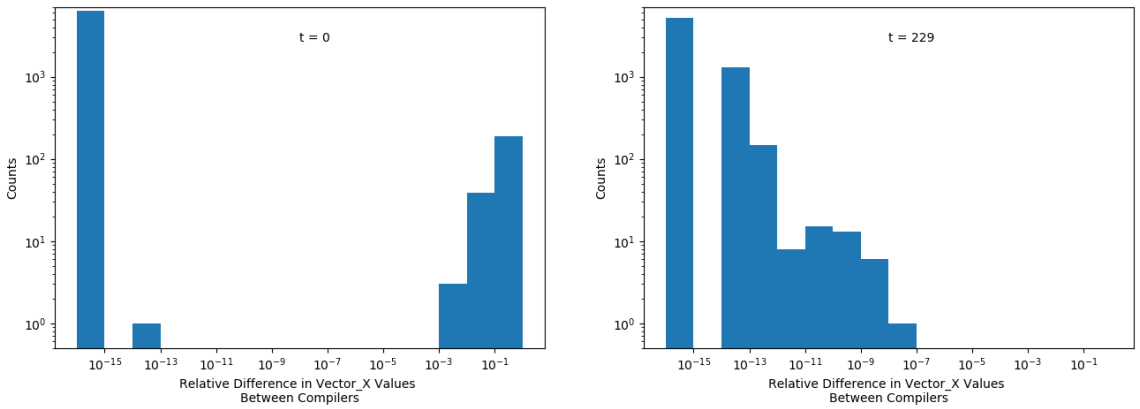
| Reporting Period | May 21, 2020 - May 28, 2020 |
| Activities | • Completed building of Docker container for CUDA development on U of W servers. Instructions will be added to existing setup document.<br>• Building QRFactor in container must be done with Makefile; GUI forwarding through ssh tunnel not possible. Building and running QRFactor within the container environment is ongoing.<br>• Processed and examined output data from *Province* provided by MHI. Output data $X(t)$ given for two builds that used different compilers. A relative difference comparison between data generated by the two compilers had relative differences on the order of $10^{-13}$. For early time steps, the relative difference was worse. See figure 1.<br>• Further compared the output of QRFactor for CPU and GPU methods at different time steps (figure 2). Randomly chosen output data was compared and the relative differences between the CPU-based solution and GPU-based solutions did not exceed the relative differences present in the provided output data. The exception being three lines that are known to cause issues.<br>• Output data was not found to be sensitive to the internal QR factoring tolerance level beyond the ability to complete the factoring. |
| Issues | • None |
| Milestones Accomplished | • Docker container constructed on U of W servers for CUDA development.<br>• Analysis of output data provided by MHI for different compilers.<br>• Comparison of GPU-based solve and CPU-based solve in QRFactor did not yield significantly different results. |
| Milestones Not Accomplished | • None |
| Next Week's Milestones | • Full run of *Province* data on U of W servers. |
| Forwarded Issues | • None |




(a) Histogram of the relative difference between output vectors from CompilerGF462 and CompilerIF15 for the $t = 0$ time step.

(b) Histogram of the relative difference between output vectors from CompilerGF462 and CompilerIF15 for the $t = 229$ time step.

Figure 1: A comparison of output data at two time steps between the two provided compilers.

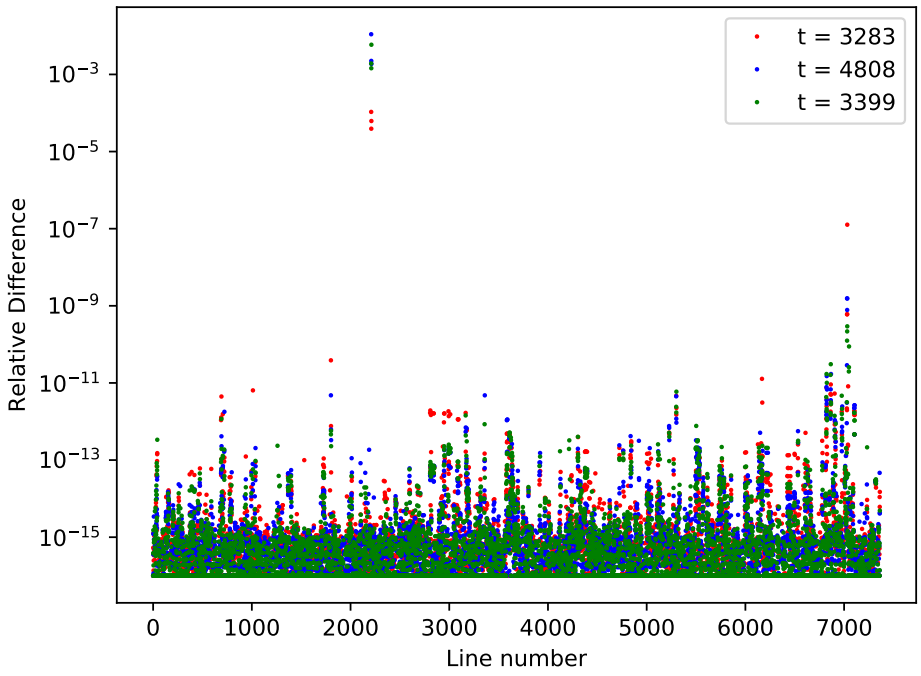



Figure 2: The relative difference between CPU-based solver and GPU-based solver for the *Province* data set at the three specified time steps. Solving was done with a tolerance level in QR factorization of $10^{-16}$.