**GPU Solutions for PSCAD: IT17112**

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| Reporting Period | June 11, 2020 - June 18, 2020 |
| Activities | • Ran a final check on self-consistency between two compilers of *Province* data set. See figure 1 for details. Observed that the relative differences between values of **x** over all time steps is small on average, but does contain some significant variation, while **b** demonstrated a much greater degree of variation.<br>• Compiled and ran QRFactor on both NVIDIA Tesla P100 and NVIDIA V100 PCIe. See table 1 for a summary of hardware characteristics.<br>• **Best performance**: While the V100 card took approximately 9 ms to perform the one-time factoring of the full system matrix $A$, it provided an average solving time of 0.5 ms per time step. With this timing, the *Province* data set could be solved for a million time steps in only 8.3 minutes. See figure 2 for a comparison of timings for various hardware. |
| Issues | • None |
| Milestones Accomplished | • Ran QRFactor on Telsa P100 and V100 PCIe cards, and collected new timing data.<br>• Significant per-time step speedup achieved on V100 hardware; average per-time step solve time $0.5ms$. |
| Milestones Not Accomplished | • None |
| Next Week's Milestones | • Discuss next steps. |
| Forwarded Issues | • None |

| NVIDIA GPU | Compute Version | CUDA Cores | Double-Precision Performance |
|---|---|---|---|
| Quadro RTX 3000 | 7.5 | 2304 | 198.7 GFLOPs |
| Tesla P100 | 6.0 | 3584 | 4.7 TFLOPs |
| V100 PCIe | 7.0 | 5120 | 7.8 TFLOPs |

Table 1: Short summary of hardware specifications for the three types of GPUs used. Links are to the respective hardware datasheets.

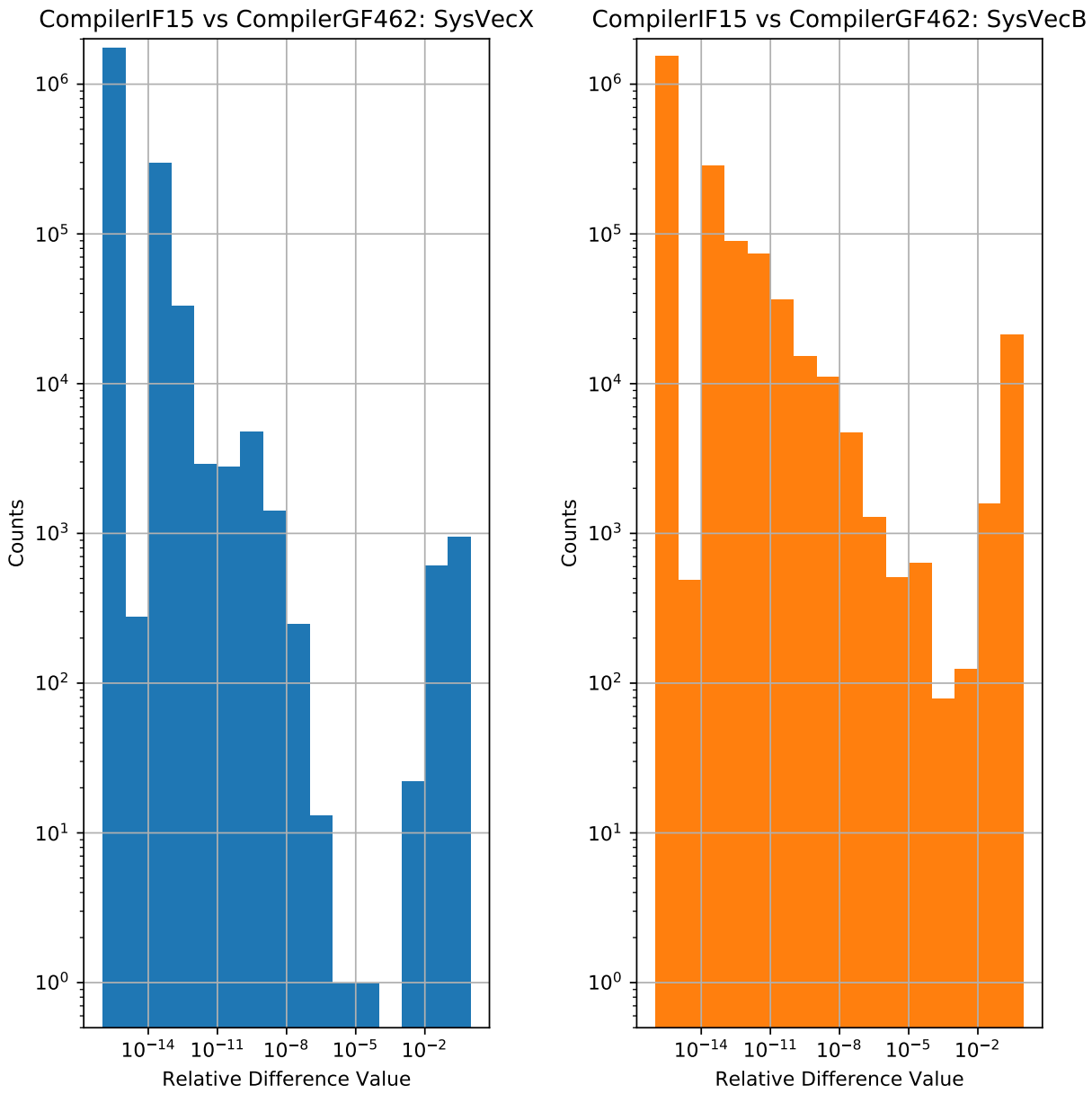


Figure 1: *Left* The relative difference between the full system output vectors $\mathbf{X}$ in CompilerIF15 and CompilerGF462, over all time steps. *Right* The same comparison, but applied to full system input vectors $\mathbf{B}$.

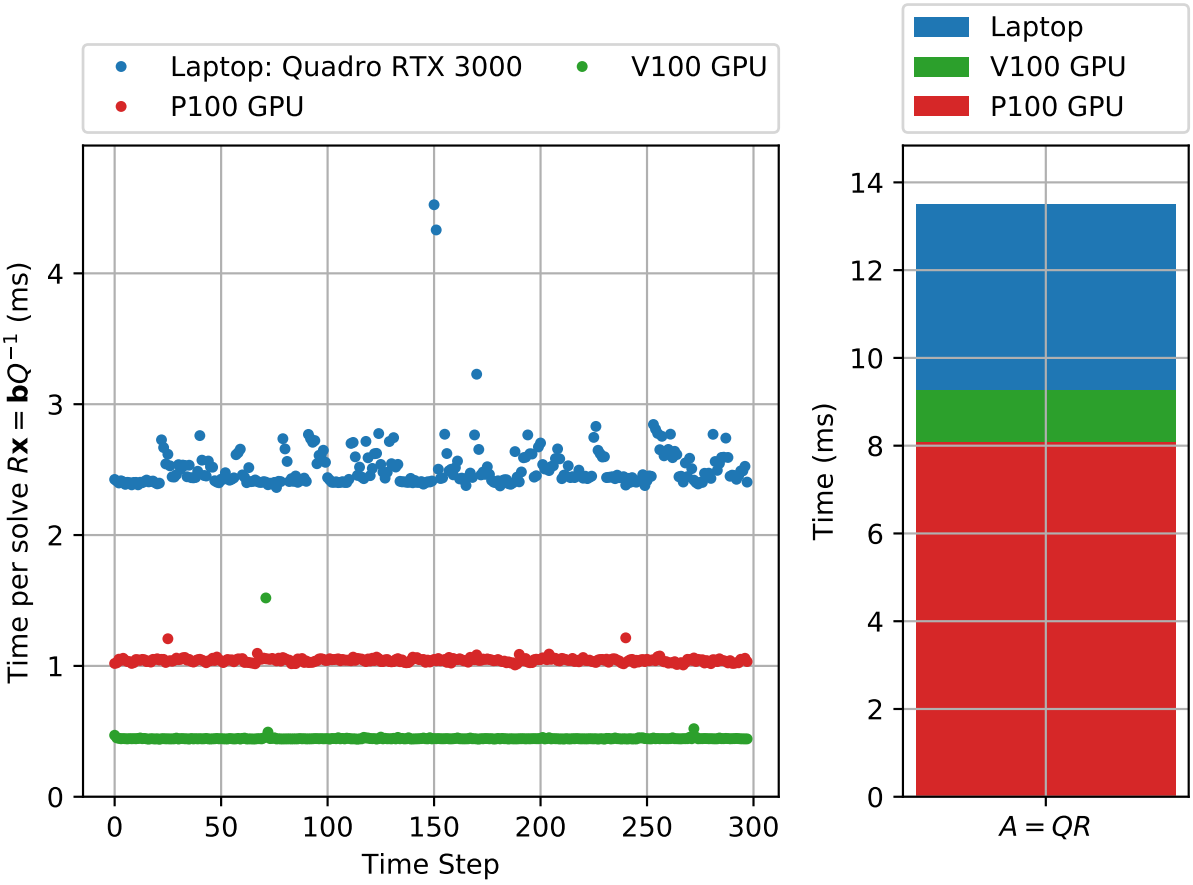


Figure 2: *Left* Time in milliseconds to solve the pre-factored system $R\mathbf{x} = \mathbf{b}Q^{-1}$ at each time step for the three hardware choices. *Right* Time in milliseconds to perform the factoring of the full system matrix $A$ into $QR$ for each of the hardware choices. Note that while the V100 takes slightly longer to perform the one-time factoring of the matrix, it outperforms the other hardware choices after the factoring is done.