How is the error computed:

Relative residual:

$$\text{RR} = \frac{\|b - Ax\|}{\|b\|}$$

Componentwise Relative Backward Error (CRBE)

$$\text{CRBE} = \max_{i=1,\ldots,n} \frac{\left|b_i - \sum_{j=1}^{n} a_{ij} x_j\right|}{|b_i| + \sum_{j=1}^{n} |a_{ij}||x_j|}$$

Name	Rows	Columns	NNZ un	NNZ L+U	NNZ inc	av. RR	av. CRBE	Failure rate
TAMU 500	56010	56010	410882	2380636.75	5.79 x	$6.55 \cdot 10^{-9}$	$2.13 \cdot 10^{-7}$	0 %
Case 118	214492	214492	2343288	11617546.5	4.96 x	$3.55 \cdot 10^{-14}$	$4.63 \cdot 10^{-14}$	0 %
RTS – 1 TP	2237	2237	11297	103768.88	9.19 x	$2.17 \cdot 10^{-10}$	$2.17 \cdot 10^{-9}$	5 %
RTS – 2 TP	4766	4766	23762	236026.73	9.93 x	$2.94 \cdot 10^{-8}$	$6.56 \cdot 10^{-7}$	4 %
ACTIVSg200	4644	4644	21630	196132.4	9.07x	$1.32 \cdot 10^{-8}$	$2.05 \cdot 10^{-7}$	0 %
ACTIVSg2000	55667	55667	268299	6040143	22.30x	$5.26 \cdot 10^{-10}$	$2.05 \cdot 10^{-11}$	0 %
ACTIVSg10k	238072	238072	1111990.8	40501771.2	36.42x	$2.48 \cdot 10^{-3}$	$1.07 \cdot 10^{-12}$	0 %
ACTIVSg70k	1640411	1640411	7671693	355144058.2	46.29x	$7.19 \cdot 10^{-3}$	$7.50 \cdot 10^{-11}$	0 %

Table 1: The error levels achieved in STRUMPACK. The results for last three test cases were obtained by increasing the density of nested disection i.e., ramping up the parameter to 25, 50 and 64, respectively (default is 8.)

The computations performed by STRUMPACK can be divided into 5 phases:

1. Nested dissection,
2. Symmetrization,
3. Symbolic factorization,
4. Factorization,
5. Solve (including IR, Richardson by default).

All results presented in this document have been computed on one node of Oak Ridge OLCF summit supercomputer.

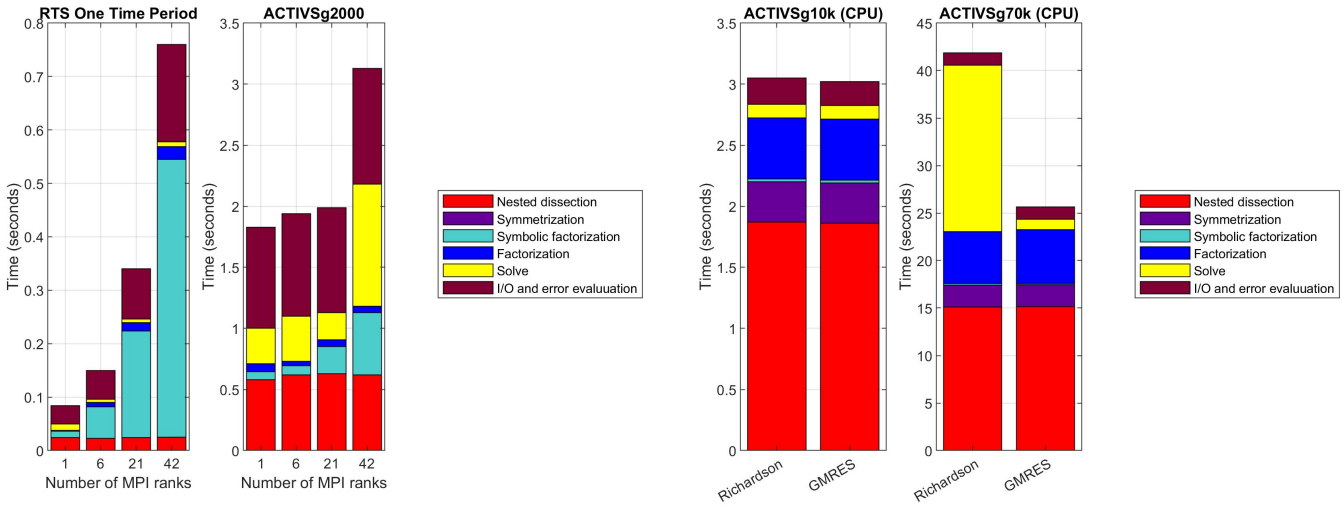

Figure 1: STRUMPACK performance results on CPU(without GPU acceleration). The figure on the right was created using ome rank.

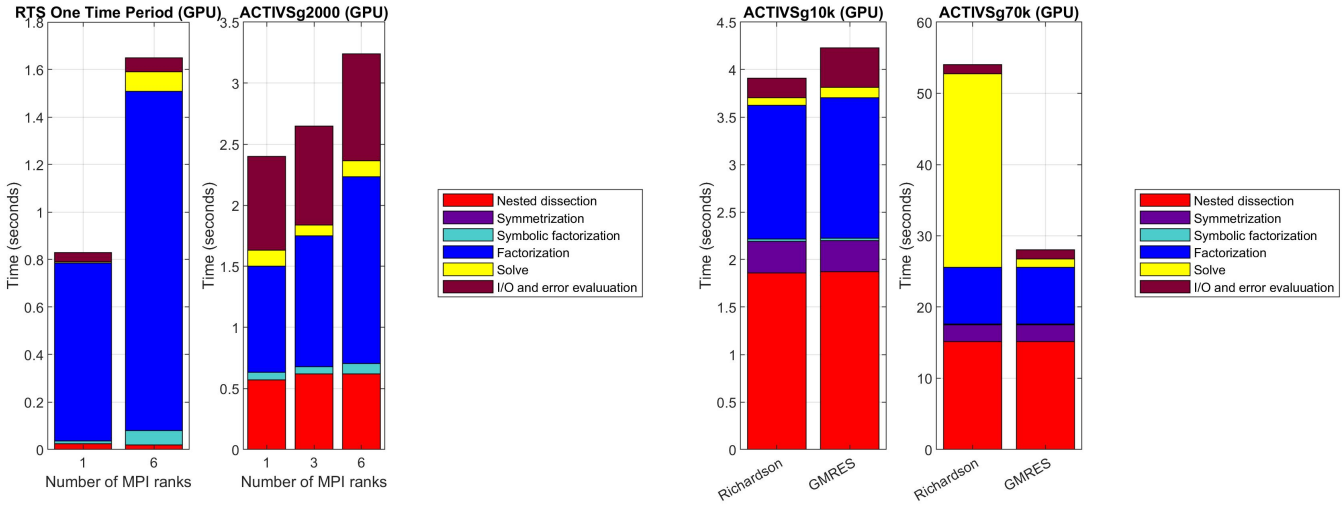

Figure 2: STRUMPACK performance results on GPU. The figure on the right was created using ome rank.

TAMU 500 (CPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.41	1.27e-05	0.091	0.047	0.044	1.41
6	0.42	1.31e-05	0.077	0.032	0.037	1.44
21	0.42	1.30e-05	0.21	0.038	0.021	1.59
42	0.42	7.45e-05	0.53	0.040	0.021	1.98

Case 118 (CPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	1.92	1.91e-05	0.33	0.20	0.11	6.88
6	1.99	1.51e-05	0.12	0.053	0.088	6.66
21	2.01	1.68e-05	0.22	0.023	0.051	6.74
42	2.03	1.39e-05	0.52	0.018	0.042	7.13

RTS - One Time Period (CPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.024	1.27e-05	0.012	0.002	0.012	0.084
6	0.023	1.26e-05	0.059	0.008	0.006	0.15
21	0.024	4.93e-05	0.20	0.015	0.007	0.34
42	0.025	1.49e-04	0.52	0.024	0.009	0.76

RTS - Two Time Period (CPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.041	3.19e-06	0.007	0.005	0.021	0.13
6	0.045	6.76e-06	0.055	0.013	0.010	0.22
21	0.044	1.89e-05	0.21	0.020	0.009	0.41
42	0.044	1.15e-04	0.52	0.022	0.010	0.80

ACTIVSg200 (CPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.039	6.56e-06	0.01	0.009	0.014	0.15
6	0.043	5.53e-06	0.05	0.012	0.0085	0.21
21	0.044	1.85e-05	0.21	0.11	0.009	0.41
42	0.042	1.20e-04	0.52	0.27	0.009	0.80

Table 2: Performance of STRUMPACK without GPU acceleration (default RHS).

TAMU 500 (GPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.40	4.61e-07	0.073	0.85	0.023	2.12
6	0.42	6.73e-07	0.079	1.44	0.085	2.87

Case 118 (GPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	1.92	1.32e-06	0.33	1.01	0.10	7.41
6	1.99	1.46e-06	0.12	1.45	0.12	7.98

RTS - One Time Period (GPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.024	1.44e-06	0.012	0.75	0.004	0.83
6	0.020	3.43e-07	0.059	1.43	0.082	1.65

RTS - Two Time Period (GPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.046	1.59e-06	0.017	0.75	0.007	0.89
6	0.047	1.16e-06	0.062	1.43	0.093	1.73

ACTIVSg200 (GPU, default RHS)						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1	0.037	3.70e-07	0.009	0.77	0.004	0.88
3	0.047	1.42e-06	0.024	1.05	0.13	1.34
6	0.044	1.49e-06	0.059	1.43	0.13	1.75

Table 3: Performance of STRUMPACK with GPU acceleration (default RHS).

TAMU 500						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (Correct RHS, CPU)	0.40	0.039	0.01	0.039	0.015	0.58
1 (Correct RHS, GPU)	0.41	0.040	0.012	0.81	0.015	1.35

Case 118						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (Correct RHS, CPU)	1.95	0.25	0.05	0.20	0.067	2.81
1 (Correct RHS, GPU)	1.95	0.25	0.05	1.04	0.07	3.65

RTS - One Time Period						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (Correct RHS, CPU)	0.023	0.003	0.0011	0.002	0.001	0.038
1 (Correct RHS, GPU)	0.019	0.003	0.001	0.78	0.001	0.81

RTS - Two Time Period						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (Correct RHS, CPU)	0.042	0.0058	0.0013	0.0044	0.0015	0.062
1 (Correct RHS, GPU)	0.041	0.006	0.001	0.77	0.000	0.83

ACTIVSg200						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (Correct RHS, CPU)	0.041	0.00650	0.002	0.007	0.0023	0.066
1 (Correct RHS, GPU)	0.038	0.0064	0.053	0.77	0.00	0.65

Table 4: STRUMPACK results computed on the with and without GPU acceleration. Times are reported in seconds.

ACTIVSg2000						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (CPU, Richardson)	0.40	0.07	0.007	0.13	0.01	0.71
1 (CPU, GMRES)	0.58	0.07	0.012	0.06	0.11	0.92
1 (GPU, Richardson)	0.40	0.08	0.009	0.92	0.01	1.51
1 (GPU, GMRES)	0.57	0.07	0.012	0.83	0.19	1.77

ACTIVSg10k						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (CPU, GMRES)	1.86	0.33	0.024	0.50	0.11	3.02
1 (CPU, Richarson)	1.87	0.33	0.024	0.50	0.11	3.05
1 (GPU, GMRES)	1.87	0.33	0.025	1.48	0.11	4.23
1 (GPU, Richarson)	1.86	0.33	0.025	1.41	0.08	3.91

ACTIVSg70k						
Ranks	ND	Symm	Symb factor	Factor	Solve	TOTAL
1 (CPU, GMRES)	15.14	2.30	0.14	5.69	1.08	25.65
1 (CPU, Richardson)	15.11	2.32	0.14	5.47	17.53	41.86
1 (GPU, GMRES)	15.15	2.34	0.15	7.93	1.19	28.06
1 (GPU, Richardson)	15.16	2.34	0.14	7.94	27.17	54.06

Table 5: The new timing results for STRUMPACK, obtained by increasing the depth of nested dissection and by varying the iterative refinement strategy.