

Supplementary Files for “Multiobjective Multitask Optimization via Diversity and Convergence Oriented Knowledge Transfer”

Yanchi Li, Dongcheng Li, Wenyin Gong, *Member, IEEE*, and Qiong Gu

S-I. PERFORMANCE METRIC

The IGD+ [1] for a non-dominated solution set \mathcal{S} in M -dimensional objective space is calculated as

$$\text{IGD+}(\mathcal{S}, \mathcal{Z}) = \frac{1}{|\mathcal{Z}|} \sum_{j=1}^{|\mathcal{Z}|} \min_{s_i \in \mathcal{A}} d(s_i, z_j), \quad (1)$$

where \mathcal{Z} in IGD+ is the set of optimal reference points, and $d(s, z)$ is calculated as

$$d(s, z) = \sqrt{\sum_{k=1}^M (\max\{s^k - z^k, 0\})^2}. \quad (2)$$

The smaller the value of IGD+ the better performance.

The HV [2] of \mathcal{S} is calculated as

$$\text{HV}(\mathcal{S}, \mathcal{Z}) = \text{VOL}(\bigcup [s^1, z^1] \times, \dots, \times [s^M, z^M]), \quad (3)$$

where VOL indicates the Lebesgue measure, and \mathcal{Z} in HV is the best non-dominated solution set of all algorithms after 30 runs. The bigger the value of HV means the better performance.

S-II. HYPER-PARAMETER SETTINGS

The detailed hyper-parameter settings of the proposed MTEA-DCK and other comparison algorithms are as follows:

- MTEA-DCK: $\tau = 0.1$, $\alpha_0^c = 0.3$;
- MO-MFEA [3]: $rmp = 0.3$, $\eta_c = 20$, $\eta_m = 15$;
- MO-MFEA-II [4]: $\eta_c = 20$, $\eta_m = 15$;
- MOMFEA-SADE [5]: $rmp = 0.3$, $e = 60$, $\alpha = 0.6$, $\beta = 0.5$;
- EMT-ET [6]: $n = 8$, $\lambda \sim \mathcal{U}(0, 2)$, $p = 0.5$, $\eta_c = 20$, $\eta_m = 15$;
- EMT-PD [7]: $g = 5$, $rmp = 0.3$, $\eta_c = 20$, $\eta_m = 15$;
- EMT-GS [8]: $t = 10$, $lr_D = 0.0002$, $lr_G = 0.0003$, $s = 10$, $F \sim \mathcal{N}(0.5, 0.2)$;
- MO-SBO [9]: $B = 0.25$, $H = 0.5$, $\eta_c = 20$, $\eta_m = 15$;
- MO-MaTDE [10]: $\alpha = 0.1$, $\text{ArcUpdate} = 0.2$, $\text{Shrink} = 0.8$, $\text{Ro} = 0.8$, $\text{ArcMultip} = 3$, $\text{LF} = 0.1$, $\text{UF} = 2$, $\text{LCR} = 0.1$, $\text{UCR} = 0.9$;
- SPEA2 [11]: $\eta_c = 20$, $\eta_m = 15$;
- NSGA-III [12]: $\eta_c = 20$, $\eta_m = 15$;
- MOEA/D-DE [13]: $\delta = 0.9$, $nr = 2$, $F = 0.5$, $CR = 0.9$, $\eta_m = 15$;
- LMOCSO [14]: $\eta_m = 15$;
- CCMO [15]: $\eta_c = 20$, $\eta_m = 15$;
- CMOCOSO [16]: $\eta_c = 20$, $\eta_m = 15$.

TABLE S-I
COMBINATION OF OBJECTIVE FUNCTIONS OF DIFFERENT CASES OF MULTIOBJECTIVE OPTIMAL POWER FLOW PROBLEMS.

	Generation cost	Emission	Power loss	Voltage deviation
Case 1	✓	✓		
Case 2	✓	✓	✓	
Case 3	✓	✓		✓
Case 4	✓	✓	✓	✓

S-III. REAL-WORLD APPLICATION PROBLEMS

A. Case 1: Optimal Power Flow

The objective functions and constraints of OPF [17], [18] can be described as

$$\begin{aligned}
 \text{Minimize : } \quad f_1(\mathbf{x}) &= \sum_{i=1}^{ng} a_i + b_i P_{G_i} + c_i P_{G_i}^2, \\
 f_2(\mathbf{x}) &= \sum_{i=1}^{ng} \alpha_i + \beta_i P_{G_i} + \gamma_i P_{G_i}^2 + \varrho e^{(\phi_i P_{G_i})}, \\
 f_3(\mathbf{x}) &= \sum_{i=1}^{nn} \sum_{j \neq i}^{nn} G_{ij} (V_i^2 + V_j^2 - \\
 &\quad 2V_i V_j \cos(\delta_i - \delta_j)), \\
 f_4(\mathbf{x}) &= \sum_{i=1}^{nl} |V_{L_i} - 1.0|, \\
 \text{subject to : } \quad P_{G_i}^{\min} \leq &P_{G_i} \leq P_{G_i}^{\max}, \quad i = 1, \dots, ng, \\
 Q_{G_i}^{\min} \leq &Q_{G_i} \leq Q_{G_i}^{\max}, \quad i = 1, \dots, ng, \\
 V_{G_i}^{\min} \leq &V_{G_i} \leq V_{G_i}^{\max}, \quad i = 1, \dots, ng, \\
 Q_{C_i}^{\min} \leq &V_{C_i} \leq V_{C_i}^{\max}, \quad i = 1, \dots, nc, \\
 T_i^{\min} \leq &T_i \leq T_i^{\max}, \quad i = 1, \dots, nt, \\
 V_{L_i}^{\min} \leq &V_{L_i} \leq V_{L_i}^{\max}, \quad i = 1, \dots, nl, \\
 S_{l_i}^{\min} \leq &V_{l_i} \leq V_{l_i}^{\max}, \quad i = 1, \dots, nn,
 \end{aligned} \tag{4}$$

where $\mathbf{x} = (P_{G_2}, \dots, P_{G_{ng}}, V_{G_1}, \dots, V_{G_{ng}}, Q_{C_1}, \dots, Q_{C_{nc}}, T_1, \dots, T_{nt})$. Different bus systems constitute different OPF problems according to the above objectives and constraints. Here we use two different bus systems, IEEE-30 and IEEE-57, to form two-task MO-MTOPs. IEEE-30 is a relatively easy bus system with 24-dimensional decision variables. IEEE-57 is a more complex bus system with 33-dimensional decision variables. Based on this task combination, a total of four cases are constructed according to different objective combinations as in Table S-I.

B. Case 2: Synchronous Optimal Pulse-width Modulation

TABLE S-II
SYNCHRONOUS OPTIMAL PULSE-WIDTH MODULATION WITH DIFFERENT LEVEL INVERTERS.

Level	D	n	m	s
3	25	1	0.32	[-1,1,-1,1,-1,1,-1,1,-1,1]
5	25	2	0.32	[1,-1,1,1,-1,1,-1,1,-1]
7	25	3	0.36	[1,-1,1,1,1,-1,1,-1,1,-1]
9	30	4	0.32	[1,1,1,1,-1,1,-1,1,-1,1,-1]
11	30	5	0.3333	[1,-1,1,1,1,-1,1,-1,1,1,1,1]
13	30	6	0.32	[1,1,1,-1,1,-1,1,-1,1,1,1,1]

A SOPM problem [19], [20] can be defined as a bi-objective constrained optimization problem as

$$\begin{aligned}
 \text{Minimize : } f_1(\mathbf{x}) &= \frac{\sqrt{\sum_k (k^{-4})(\sum_{i=1}^D s_i \cos(kx_i))^2}}{n \sqrt{\sum_k k^{-4}}}, \\
 f_2(\mathbf{x}) &= (nm - \sum_{i=1}^D s_i \cos(x_i))^2, \\
 \text{subject to : } x_{i+1} - x_i - 10^{-5} &> 0, i = 1, 2, \dots, N-1, \\
 0 < x_i < \frac{\pi}{2}, i &= 1, 2, \dots, N,
 \end{aligned} \tag{5}$$

where $\mathbf{x} = (x_1, x_2, \dots, x_D)$ and $k = 5, 7, 11, 13, \dots, 97$. Six SOPM problems with different levels used in [21] are chosen as optimization tasks and their detailed parameters are shown in Table S-II. The combinations of levels 3, 5, and 7 become the first three-task MO-MTOP of SOPM. The combinations of levels 9, 11, and 13 become the second MO-MTOP. The tasks in each MO-MTOP of SOPM have the same variable dimension, the same variable structure constraints, and different objective functions.

C. Case 3: Sensor Coverage Problem

A bi-objective SCP [22], [23] can be described as

$$\begin{aligned}
 \text{Minimize : } f_1(\mathbf{x}) &= 1 - \frac{\mathbf{A} \bigcup_{i=1}^S \pi r_i^2(x_i, y_i)}{\mathbf{A}}, \\
 f_2(\mathbf{x}) &= \sum_{i=1}^S (1 + 10 \cdot r_i^2), \\
 \text{subject to : } -1 < x_i < 1, \\
 -1 < y_i < 1, \\
 0.1 < r_i < 0.25,
 \end{aligned} \tag{6}$$

where $\mathbf{x} = (x_1, y_1, r_1, \dots, x_S, y_S, r_S)$. Since the number of sensors is uncertain, the length of the variables is also uncertain, for each possible variable length is an optimization task. The final result required for multiobjective SCP is the non-dominated solution set after merging all task solution sets. As the set of solutions for different tasks may be in conflict, this type of problem is also called the competitive MO-MTOP.

TABLE S-III
SENSOR COVERAGE PROBLEMS.

Problem	T	D	Sensor number
SCP(28-32)	5	[84, 87, ..., 96]	[28, 29, ..., 32]
SCP(25-34)	10	[75, 78, ..., 102]	[25, 26, ..., 34]

REFERENCES

- [1] H. Ishibuchi, R. Imada, N. Masuyama, and Y. Nojima, "Comparison of hypervolume, igd and igd+ from the viewpoint of optimal distributions of solutions," in *Evolutionary Multi-Criterion Optimization*, K. Deb, E. Goodman, C. A. Coello Coello, K. Klamroth, K. Miettinen, S. Mostaghim, and P. Reed, Eds. Cham: Springer International Publishing, 2019, pp. 332–345.
- [2] E. Zitzler and L. Thiele, "Multiobjective evolutionary algorithms: A comparative case study and the strength pareto approach," *IEEE Transactions on Evolutionary Computation*, vol. 3, no. 4, pp. 257–271, 1999.
- [3] A. Gupta, Y.-S. Ong, L. Feng, and K. C. Tan, "Multiobjective multifactorial optimization in evolutionary multitasking," *IEEE Transactions on Cybernetics*, vol. 47, no. 7, pp. 1652–1665, 2017.
- [4] K. K. Bali, A. Gupta, Y.-S. Ong, and P. S. Tan, "Cognizant multitasking in multiobjective multifactorial evolution: Mo-mfea-ii," *IEEE Transactions on Cybernetics*, vol. 51, no. 4, pp. 1784–1796, 2021.
- [5] Z. Liang, H. Dong, C. Liu, W. Liang, and Z. Zhu, "Evolutionary multitasking for multiobjective optimization with subspace alignment and adaptive differential evolution," *IEEE Transactions on Cybernetics*, vol. 52, no. 4, pp. 2096–2109, 2022.
- [6] J. Lin, H.-L. Liu, K. C. Tan, and F. Gu, "An effective knowledge transfer approach for multiobjective multitasking optimization," *IEEE Transactions on Cybernetics*, vol. 51, no. 6, pp. 3238–3248, 2021.
- [7] Z. Liang, W. Liang, Z. Wang, X. Ma, L. Liu, and Z. Zhu, "Multiobjective evolutionary multitasking with two-stage adaptive knowledge transfer based on population distribution," *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 52, no. 7, pp. 4457–4469, 2022.
- [8] Z. Liang, Y. Zhu, X. Wang, Z. Li, and Z. Zhu, "Evolutionary multitasking for optimization based on generative strategies," *IEEE Transactions on Evolutionary Computation*, vol. 27, no. 4, pp. 1042–1056, 2023.
- [9] R.-T. Liaw and C.-K. Ting, "Evolutionary manytasking optimization based on symbiosis in biocoenosis," *Proceedings of the AAAI Conference on Artificial Intelligence*, vol. 33, no. 01, pp. 4295–4303, Jul. 2019.
- [10] Y. Chen, J. Zhong, L. Feng, and J. Zhang, "An adaptive archive-based evolutionary framework for many-task optimization," *IEEE Transactions on Emerging Topics in Computational Intelligence*, vol. 4, no. 3, pp. 369–384, 2020.

- [11] E. Zitzler, M. Laumanns, and L. Thiele, "Spea2: Improving the strength pareto evolutionary algorithm for multiobjective optimization," in *Evolutionary Methods for Design, Optimization and Control with Applications to Industrial Problems. Proceedings of the EUROGEN'2001. Athens, Greece, September 19-21, 2001*.
- [12] K. Deb and H. Jain, "An evolutionary many-objective optimization algorithm using reference-point-based nondominated sorting approach, part i: Solving problems with box constraints," *IEEE Transactions on Evolutionary Computation*, vol. 18, no. 4, pp. 577–601, 2014.
- [13] H. Li and Q. Zhang, "Multiobjective optimization problems with complicated pareto sets, moea/d and nsga-ii," *IEEE Transactions on Evolutionary Computation*, vol. 13, no. 2, pp. 284–302, 2009.
- [14] Y. Tian, X. Zheng, X. Zhang, and Y. Jin, "Efficient large-scale multiobjective optimization based on a competitive swarm optimizer," *IEEE Transactions on Cybernetics*, vol. 50, no. 8, pp. 3696–3708, 2020.
- [15] Y. Tian, T. Zhang, J. Xiao, X. Zhang, and Y. Jin, "A coevolutionary framework for constrained multiobjective optimization problems," *IEEE Transactions on Evolutionary Computation*, vol. 25, no. 1, pp. 102–116, 2021.
- [16] F. Ming, W. Gong, D. Li, L. Wang, and L. Gao, "A competitive and cooperative swarm optimizer for constrained multi-objective optimization problems," *IEEE Transactions on Evolutionary Computation*, vol. 27, no. 5, pp. 1313–1326, 2023.
- [17] S. Li, W. Gong, L. Wang, and Q. Gu, "Multi-objective optimal power flow with stochastic wind and solar power," *Applied Soft Computing*, vol. 114, p. 108045, 2022.
- [18] S. Li, W. Gong, C. Hu, X. Yan, L. Wang, and Q. Gu, "Adaptive constraint differential evolution for optimal power flow," *Energy*, vol. 235, p. 121362, 2021.
- [19] A. K. Rathore, J. Holtz, and T. Boller, "Synchronous optimal pulsewidth modulation for low-switching-frequency control of medium-voltage multilevel inverters," *IEEE Transactions on Industrial Electronics*, vol. 57, no. 7, pp. 2374–2381, 2010.
- [20] A. Edpuganti and A. K. Rathore, "Optimal pulsewidth modulation for common-mode voltage elimination scheme of medium-voltage modular multilevel converter-fed open-end stator winding induction motor drives," *IEEE Transactions on Industrial Electronics*, vol. 64, no. 1, pp. 848–856, 2017.
- [21] A. Kumar, G. Wu, M. Z. Ali, Q. Luo, R. Mallipeddi, P. N. Suganthan, and S. Das, "A benchmark-suite of real-world constrained multi-objective optimization problems and some baseline results," *Swarm and Evolutionary Computation*, vol. 67, p. 100961, 2021.
- [22] M. L. Ryerkerk, R. C. Averill, K. Deb, and E. D. Goodman, "Solving metameric variable-length optimization problems using genetic algorithms," *Genetic Programming and Evolvable Machines*, vol. 18, no. 2, pp. 247–277, 2017.
- [23] G. Li, Q. Zhang, and Z. Wang, "Evolutionary competitive multitasking optimization," *IEEE Transactions on Evolutionary Computation*, vol. 26, no. 2, pp. 278–289, 2022.

S-IV. DETAILED RESULTS

TABLE S-IV

AVERAGE IGD+ VALUES FOR COMPARISON ON THREE MULTIOBJECTIVE MULTITASK BENCHMARK SUITES.

	SPEA2	NSGA-III	MOEA/D-DE	LMOCSO	MO-MFEA	MO-MFEA-II	MOMFEA-SADE	EMT-ET	EMT-PD	EMT-GS	MTEA-DCK	
B17-P1-T1	1.0957e+00 (2.50e-01) +	3.5732e+00 (7.42e-01) -	5.5442e+00 (7.48e+00) -	8.7274e-02 (2.46e-02) -	2.7526e-01 (5.27e-02) -	5.9892e-03 (1.31e-03) -	1.4444e+00 (5.48e+00) -	3.1842e-01 (7.11e-02) -	1.3624e-01 (3.37e-02) -	1.9735e-03 (5.31e-05) -	1.9089e-03 (4.50e-05)	
B17-P1-T2	6.1786e-01 (1.09e-01) -	1.4925e+00 (1.76e-01) -	1.1752e+00 (1.01e+00) -	6.3421e-01 (1.60e-01) -	5.3924e-01 (5.33e-02) -	4.9185e-02 (8.23e-03) -	3.8459e-01 (1.86e-01) -	5.7120e-01 (7.15e-02) -	7.4195e-03 (6.23e-02) -	2.5700e-03 (3.37e-05) +	2.4806e-03 (7.63e-04)	
B17-P2-T1	1.6279e-02 (9.76e-03) -	2.0446e-02 (1.31e-02) -	2.0094e-01 (1.65e-01) =	1.3126e-01 (1.48e-01) -	7.7876e-03 (5.31e-03) -	2.9545e-03 (1.46e-04) -	1.1366e-02 (1.39e-02) -	7.4195e-03 (6.23e-02) -	1.2014e-02 (7.63e-03) -	1.9646e-03 (5.86e-05) +	2.0619e-03 (8.42e-05)	
B17-P2-T2	7.0606e-01 (5.36e-01) -	7.0222e-01 (7.49e-01) -	1.9216e-03 (2.11e-05) +	2.4478e-01 (2.50e-01) -	1.3330e-02 (6.73e-03) -	8.5059e-02 (3.68e-01) -	3.6659e-03 (1.51e-04) -	1.5023e-02 (0.98e-03) -	1.2014e-02 (7.63e-03) -	1.9646e-03 (5.86e-05) +	1.9475e-03 (5.43e-05)	
B17-P3-T1	3.3187e+01 (3.69e+00) -	3.7976e+01 (4.44e+00) -	9.2284e+01 (3.03e+00) -	3.1552e+01 (9.89e+00) -	4.9846e-01 (2.99e-01) -	5.2437e-01 (2.84e-02) -	3.4384e-01 (6.45e-04) -	7.9738e-01 (6.45e-01) -	4.6517e+00 (1.14e+01) -	8.7162e+01 (1.39e+01) -	3.0363e-03 (1.06e-04) +	
B17-P4-T1	5.8554e-01 (2.22e-01) -	2.9320e+01 (6.92e-01) -	1.6761e+01 (4.61e+01) -	3.2348e+00 (2.52e-03) -	5.9141e+01 (1.43e-01) -	1.0746e+02 (2.04e-03) -	3.8843e-03 (2.88e-04) -	1.1188e-02 (4.04e-04) -	1.8780e-02 (5.85e-03) -	6.6918e-02 (1.88e-01) -	3.0363e-03 (1.06e-04) +	
B17-P4-T2	4.3101e-02 (2.20e-02) -	5.9402e-02 (2.46e-01) -	1.7753e-02 (7.13e-03) -	3.6345e-03 (4.15e-04) -	1.0724e-02 (2.08e-01) -	1.1188e-02 (4.04e-04) -	1.8780e-02 (5.85e-03) -	6.6918e-02 (1.88e-01) -	4.8647e+01 (1.01e+01) -	2.7499e+01 (4.46e+00) -	3.4022e-03 (1.99e-04)	
B17-P5-T1	1.1226e+00 (2.53e-01) -	1.7184e+00 (3.18e-01) -	6.7277e+00 (2.48e-01) -	7.1387e+01 (1.12e-01) -	9.7155e+01 (1.67e-01) -	1.2955e+00 (3.10e-02) -	9.9499e+00 (2.37e+00) -	1.2824e+01 (2.85e-01) -	4.8497e+01 (5.70e-01) -	8.3487e+01 (4.92e-02) -	3.3161e-02 (1.29e-02)	
B17-P5-T2	1.4837e+03 (4.17e+02) -	1.3663e+03 (3.64e+02) -	7.8157e+02 (1.92e+02) -	1.1579e+03 (1.38e+02) -	4.0885e+02 (1.29e+02) -	2.5005e+02 (8.74e+01) -	1.3555e+02 (1.43e-02) +	4.9093e+02 (5.84e+02) -	4.0327e+02 (1.31e+02) -	2.0725e+02 (8.10e+01) -		
B17-P6-T1	5.9485e-02 (1.38e-02) -	1.1553e-01 (1.81e-02) -	4.2946e-02 (4.28e-02) -	2.9374e-02 (2.77e-03) -	7.9349e-02 (1.35e-02) -	5.5335e-03 (3.37e-03) -	2.8209e+00 (2.71e-01) -	8.2150e-02 (1.86e-02) -	1.0884e-01 (2.31e-02) -	2.7966e-03 (2.57e-03) +	5.1482e-03 (5.75e-03)	
B17-P6-T2	2.0783e+01 (1.00e-01) -	2.0829e+01 (1.14e-01) -	1.9740e+01 (4.60e-01) -	1.7968e+01 (4.68e-00) -	3.4474e+00 (2.60e-01) -	2.0041e+01 (1.50e-02) -	3.1219e+00 (2.19e-01) -	3.5771e+00 (3.28e-01) -	2.0000e+00 (4.575e-04) -	9.1920e-03 (6.17e-03)		
B17-P7-T1	5.4362e-02 (7.84e+02) -	1.0690e-03 (7.86e+02) -	3.5434e-04 (2.90e+04) -	3.4127e+02 (2.16e-02) -	8.8268e+01 (9.28e+00) -	4.7805e+01 (4.10e-01) -	4.8502e+01 (2.15e+00) -	9.2748e+01 (1.15e+00) -	6.8245e+01 (3.82e+00) -	6.1131e+01 (2.86e+01) -	4.4965e-01 (4.53e-01)	
B17-P7-T2	3.9665e-01 (9.48e-02) -	1.9842e+00 (5.71e-01) -	1.6128e+01 (4.03e+01) -	4.3411e-02 (3.16e-02) -	5.7576e+01 (1.13e+01) -	8.8771e+01 (1.69e-02) -	1.2033e+01 (3.59e+00) -	1.3034e+01 (3.79e+00) -	1.0511e+01 (4.77e+00) +	1.7335e+01 (1.59e+01) -	2.8867e+01 (7.35e-05) -	
B17-P8-T1	1.4521e+01 (1.96e-01) -	1.8769e+01 (1.55e+01) =	4.7125e-00 (3.44e-00) +	1.7125e+00 (3.06e+01) -	2.0500e+01 (6.94e+00) -	3.0498e+01 (3.56e-01) -	1.8437e+01 (4.36e+01) -	1.2083e+01 (3.79e+00) -	1.2566e+01 (1.40e-01) -	1.6721e+01 (2.23e-01) -	1.1423e+01 (1.39e-01) -	2.3199e-03 (9.80e-04)
B17-P8-T2	9.3387e-01 (8.01e-01) -	1.0570e+00 (1.98e+00) -	2.8321e+01 (1.45e-01) -	8.7094e+00 (3.56e-00) -	2.5000e+01 (6.94e+00) -	1.0488e+01 (8.92e-01) -	1.2256e+01 (1.20e-02) -	1.7204e+01 (2.43e-02) -	1.6218e+02 (0.43e-02) -	2.7280e+02 (1.21e-02) -	1.8192e-01 (7.31e-01)	
B17-P9-T1	9.2499e-01 (2.75e-01) -	8.7332e-01 (2.03e-01) -	4.7592e+01 (4.23e-02) +	8.9133e-02 (3.23e-02) -	3.4358e+01 (1.74e-01) -	3.3638e-02 (6.66e-03) +	2.1929e+00 (2.11e-01) -	3.8410e+01 (2.92e-01) -	2.8497e+01 (4.07e-01) +	4.2844e+02 (1.37e-02) +	2.9584e-01 (7.31e-01) -	
B17-P9-T2	2.0373e+01 (3.35e-02) -	2.0502e+01 (3.29e-02) -	1.9054e+01 (4.76e+00) +	2.0355e+01 (3.78e-02) -	2.0355e+01 (1.78e-03) -	2.0295e+01 (2.17e-04) -	2.0306e+01 (1.39e-03) -	1.2406e+01 (4.01e+00) +	7.4600e-02 (9.97e-00) +	2.0307e+01 (1.82e-02) -	1.9721e+01 (3.72e-00) -	
B19-P1-T1	9.3087e-03 (1.98e-03) -	2.5908e-02 (3.68e-02) -	2.4948e-03 (3.39e-05) +	1.0819e-02 (8.72e-03) -	1.1347e-02 (1.68e-03) -	1.4701e-02 (4.79e-03) -	1.4675e-03 (8.39e-02) -	1.2822e-02 (2.12e-03) -	1.2538e-02 (1.70e-03) -	1.0291e-02 (2.02e-03) -	3.5425e-03 (1.25e-04) -	
B19-P1-T2	1.2615e-01 (4.63e-03) -	1.5259e-01 (4.99e-03) -	1.1112e-01 (1.49e-02) -	2.2851e-01 (4.38e-02) -	6.5766e-02 (1.27e-02) -	4.5278e-02 (5.67e-03) -	6.9980e-02 (1.43e-02) -	5.6996e-02 (9.35e-03) -	5.9521e-02 (9.70e-03) -	1.3622e-02 (6.48e-03)		
B19-P2-T1	5.8688e-03 (3.89e-03) -	5.9488e-03 (2.45e-03) -	1.9740e+01 (4.60e-01) -	2.0783e+01 (4.06e-01) -	2.7563e+00 (1.72e-04) -	6.4462e+00 (4.77e-04) -	7.8201e+00 (3.43e-04) -	5.4545e-03 (2.23e-03) -	6.9223e+00 (3.69e-04) -	7.4883e-03 (9.34e-04) -	3.5096e-03 (1.21e-04) -	
B19-P2-T2	6.2805e-02 (4.04e-02) -	1.1149e-01 (7.14e-02) -	4.2434e-01 (3.15e-01) -	4.0804e-01 (4.85e-02) -	2.3828e-02 (2.73e-03) -	9.7315e-02 (2.38e-02) -	2.3732e-02 (1.41e-02) -	2.6362e-02 (4.05e-02) -	2.9177e-02 (4.16e-02) -	2.0026e-02 (7.61e-02) -	3.7482e-03 (3.19e-04)	
B19-P3-T1	1.4051e-01 (5.77e-02) -	1.5365e-01 (6.22e-02) -	1.6844e-01 (4.49e-02) -	2.5346e-01 (7.53e-02) -	8.8072e-02 (2.44e-02) -	9.5602e-02 (3.95e-02) -	3.4707e-01 (2.98e-02) -	1.2171e-01 (2.09e-02) -	6.8626e-02 (2.05e-02) -	1.2171e-01 (5.09e-02) -	5.8100e-02 (2.38e-02)	
B19-P3-T2	5.7208e-02 (4.99e-03) -	6.4376e-02 (2.60e-02) -	1.2041e-02 (6.02e-02) -	1.0100e-02 (3.06e-02) -	5.5542e-02 (2.89e-02) -	4.2544e-02 (4.45e-03) -	2.9956e-02 (4.58e-03) -	3.9146e-02 (4.84e-03) -	5.4572e-02 (6.64e-03) -	1.7071e-02 (3.00e-03) -		
B19-P4-T1	4.1420e-01 (1.80e-01) -	3.3367e-01 (2.77e-02) -	2.1414e-01 (3.75e-02) -	2.3725e-01 (3.89e-02) -	2.2369e-01 (6.79e-02) -	1.1504e-01 (1.14e-02) -	1.5120e-01 (5.88e-02) +	1.9955e-01 (1.14e-01) -	2.7444e-01 (7.82e-02) -	2.6405e-01 (7.78e-02) -	1.6236e-01 (9.06e-03) -	
B19-P4-T2	4.3035e-01 (2.14e-01) -	2.9798e-01 (5.91e-02) -	2.9444e-01 (1.39e-02) -	3.0718e-01 (3.20e-02) -	2.7475e-01 (7.20e-02) -	2.1860e-01 (1.05e-01) -	1.3837e-01 (7.97e-02) +	2.9342e-01 (8.59e-02) -	3.1342e-01 (9.19e-02) -	4.1261e-01 (2.46e-01) -	2.3828e-01 (8.04e-03) -	
B19-P5-T1	3.2121e-02 (9.40e-03) -	3.3389e-02 (2.62e-02) -	3.3586e-02 (2.56e-02) -	3.2967e-02 (2.56e-02) -	6.9881e-02 (3.77e-02) -	2.9566e-02 (1.17e-02) -	1.6511e-01 (7.71e-03) -	2.3700e-02 (1.77e-02) -	2.0177e-02 (4.32e-03) -	2.7604e-02 (1.88e-03) -	1.1252e-02 (1.76e-03)	
B19-P5-T2	1.0737e-01 (2.54e-01) -	7.7575e-02 (4.46e-02) -	6.0479e-02 (5.95e-03) -	1.9371e-01 (8.84e-01) -	2.0748e-01 (7.44e-02) -	1.1931e-01 (5.66e-02) -	7.7533e-02 (4.30e-03) -	4.1517e-01 (1.46e-01) -	2.1705e-02 (7.55e-02) -	1.0668e-02 (1.90e-02) -	1.6303e-02 (7.53e-02)	
B19-P6-T1	1.5900e-01 (6.03e-02) -	1.4060e-01 (6.00e-02) -	1.4799e-01 (3.02e-02) -	2.1027e-01 (4.89e-02) -	1.3608e-01 (2.60e-02) -	1.2076e-01 (4.32e-02) -	1.0291e-01 (4.64e-02) -	4.7351e-01 (3.21e-02) -	1.6268e-01 (4.25e-02) -	1.5579e-01 (4.94e-02) -	1.7179e-02 (4.43e-02)	
B19-P6-T2	3.8187e-01 (1.16e-01) -	2.8356e-01 (5.05e-02) -	2.9467e-01 (3.64e-02) -	3.0844e-01 (4.50e-02) -	3.2396e-01 (5.63e-02) -	3.0496e-01 (4.56e-02) -	2.3398e-01 (1.09e-01) -	3.8494e-01 (7.33e-02) -	3.3463e-01 (9.44e-02) -	3.4803e-01 (1.40e-01) -	2.3830e-01 (3.67e-02)	
B19-P7-T1	2.6933e-02 (1.11e-01) -	1.6356e-01 (4.06e-02) -	1.5050e-01 (7.33e-02) -	1.7034e-01 (5.35e-02) -	1.5787e-01 (3.52e-02) -	1.7080e-01 (3.25e-02) -	0.8031e-02 (4.75e-02) -	1.1930e-01 (7.42e-02) -	1.9160e-01 (5.66e-02) -	1.9943e-01 (6.95e-02) -	1.7339e-02 (3.74e-02)	
B19-P7-T2	2.7285e-02 (1.06e-01) -	1.9846e-01 (6.00e-02) -	1.5078e-01 (7.53e-02) -	1.2015e-01 (6.14e-02) -	8.5244e-02 (3.61e-02) -	1.0154e-01 (4.08e-02) -	7.0823e-01 (1.28e-01) -	9.6202e-02 (2.78e-02) -	1.1605e-01 (5.42e-02) -	2.4744e-02 (1.28e-02) -	2.0070e-02 (4.00e-03)	
B19-P8-T1	1.7644e-02 (3.46e-02) -	9.8443e-02 (5.14e-02) -	1.2452e-02 (3.62e-02) -	1.2076e-01 (1.56e-01) -	2.7721e-01 (1.52e-01) -	2.4363e-02 (1.17e-02) -	1.8496e-01 (1.19e-01) -	2.2818e-01 (1.55e-01) -	2.0650e-01 (0.96e-02) -	5.0263e-02 (7.55e-04)		
B19-P8-T2	1.9065e-01 (1.72e-01) -	2.9298e-01 (1.67e-01) -	5.0610e-01 (2.85e-01) -	1.4380e-01 (1.13e-01) -	1.5707e-01 (7.85e-02) -	3.2710e-01 (1.29e-01) -	3.2701e-01 (1.29e-01) -	6.1644e-01 (3.90e-01) -	2.4674e-01 (3.15e+00) -	1.3266e-02 (1.48e-02) -	1.3630e-01 (1.99e-00)	
B19-P9-T1	5.4071e+02 (3.10e+02) -	3.6786e+02 (1.35e+01) -	5.3987e-02 (4.49e-03) +	2.5283e+02 (3.74e+02) -	1.9822e+02 (3.03e+02) -	3.2488e+02 (1.72e+02) -	1.9891e+02 (1.16e+01) -	3.5188e+02 (0.93e+02) -	3.5757e+02 (7.53e+02) -	4.3135e+01 (4.00e+01) -	1.0962e-01 (8.33e+02)	
B19-P9-T2	2.8085e-02 (6.03e-02) -	2.5900e-02 (4.52e-02) -	2.8209e-02 (2.78e-02) -	2.8384e-02 (2.72e-02) -	2.8384e-02 (1.57e-02) -	2.2250e-01 (1.22e-01) -	1.6502e-01 (5.52e-02) -	5.8193e-01 (3.90e-02) -	1.6230e-01 (1.22e-01) -	1.4547e-01 (4.09e-02) -	1.8652e-01 (1.06e-01)	
B21-P1-T1	9.8874e-02 (2.72e-02) -	5.1342e-02 (1.30e-02) -	2.1746e-01 (3.74e-02) -	2.2711e-01 (3.47e-02) -	2.0250e-01 (4.03e-02) -	2.0253e-01 (6.99e-02) -	2.2901e-01 (8.75e-02) -	3.7091e-01 (7.60e-02) -	2.0244e-01 (4.82e-02) -	2.1969		

TABLE S-V
AVERAGE HV VALUES FOR COMPARISON ON THREE MULTI OBJECTIVE MULTITASK BENCHMARK SUITES.

	SPEA2	NSGA-III	MOEA/D-DE	LMOCSO	MO-MFEA	MO-MFEA-II	MOMFEA-SADE	EMT-ET	EMT-PD	EMT-GS	MTEA-DCK
B17-P1-T1	0 (0) -	0 (0) -	1.5787e-03 (8.65e-03) -	2.4872e-01 (1.70e-02) -	7.0709e-02 (2.97e-02) -	3.4127e-01 (1.92e-03) -	7.4948e-02 (3.24e-02) -	5.1353e-02 (2.95e-02) -	1.6934e-01 (3.32e-02) -	3.4772e-01 (9.59e-05) -	3.4731e-01 (8.29e-05)
B17-P1-T2	1.2266e-02 (1.71e-02) -	0 (0) -	3.5164e-03 (8.78e-03) -	6.8999e-03 (2.19e-02) -	2.7277e-02 (1.65e-02) -	3.7878e-01 (1.08e-02) -	7.5912e-02 (2.99e-02) -	2.1394e-02 (1.83e-02) -	9.2318e-02 (2.67e-02) -	4.4385e-01 (3.39e-04) +	4.4308e-01 (6.43e-04)
B17-P2-T1	4.2385e-01 (1.39e-02) -	4.1800e-01 (1.84e-02) -	2.3255e-01 (1.76e-01) -	3.0271e-01 (1.17e-01) -	4.3522e-01 (9.67e-03) -	4.3655e-03 (8.02e-03) -	4.4402e-01 (2.43e-04) -	4.3129e-01 (1.91e-02) -	4.3692e-01 (8.95e-03) -	4.4446e-01 (1.59e-04) -	4.4474e-01 (1.24e-04)
B17-P2-T2	5.3347e-02 (9.13e-02) -	8.1991e-02 (1.04e-01) -	3.4715e-01 (3.51e-05) +	1.4860e-01 (1.13e-01) -	3.3050e-01 (9.30e-03) -	3.1359e-01 (7.43e-02) -	3.4439e-01 (2.76e-04) -	3.2759e-01 (1.37e-02) -	3.3236e-01 (1.07e-02) -	3.4723e-01 (1.16e-04) +	3.4706e-01 (1.46e-04)
B17-P3-T1	0 (0) -	0 (0) -	0 (0) -	0 (0) -	2.6829e-02 (2.74e-02) -	3.4219e-01 (1.29e-03) -	2.8097e-02 (1.06e-02) -	1.6388e-02 (2.26e-02) -	7.9838e-02 (8.11e-02) -	1.5520e-01 (1.52e-01) -	3.4726e-01 (1.01e-04)
B17-P3-T2	6.7958e-01 (2.73e-02) -	6.5512e-01 (1.13e-01) -	6.9950e-01 (8.90e-03) -	7.1400e-01 (6.05e-04) -	7.0841e-01 (3.40e-03) -	7.1845e-01 (3.30e-04) -	7.0812e-01 (5.32e-04) -	7.0455e-01 (7.33e-03) -	6.5521e-01 (1.70e-01) -	7.1975e-01 (1.67e-04) +	7.1920e-01 (3.09e-04)
B17-P4-T1	1.5847e-01 (8.65e-02) -	0 (0) -	3.1134e-02 (8.79e-02) -	6.7946e-01 (6.84e-03) -	1.3931e-01 (9.14e-02) -	7.0886e-01 (0) -	0 (0) -	4.6501e-02 (8.23e-02) -	1.3487e-01 (1.09e-01) -	7.2000e-01 (1.17e-04) +	7.1950e-01 (5.65e-04)
B17-P4-T2	0 (0) -	0 (0) -	0 (0) -	0 (0) -	1.8893e-01 (3.63e-02) -	0 (0) =	0 (0) =	1.8711e-01 (3.39e-02) -	3.9344e-03 (1.42e-02) -	2.4901e-01 (6.11e-02) -	3.1543e-01 (1.73e-02)
B17-P5-T1	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B17-P5-T2	2.6887e-01 (1.95e-02) -	1.9197e-01 (2.05e-02) -	2.9174e-01 (5.16e-02) -	3.1040e-01 (1.39e-02) -	2.3645e-01 (1.95e-02) -	3.4181e-01 (4.79e-03) -	0 (0) -	2.3378e-01 (2.54e-02) -	1.9850e-01 (2.81e-02) -	3.4663e-01 (3.73e-03) +	3.4267e-01 (8.17e-03)
B17-P6-T1	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	3.4014e-01 (8.46e-03)
B17-P7-T1	0 (0) -	0 (0) -	0 (0) -	0 (0) -	7.1355e-02 (6.05e-03) -	5.4885e-02 (2.50e-02) -	0 (0) -	0 (0) -	1.0481e-01 (8.90e-02) -	1.2079e-01 (8.84e-03)	
B17-P7-T2	2.8159e-01 (8.01e-02) -	0 (0) -	4.7963e-02 (1.05e-01) -	6.6657e-02 (3.55e-02) -	3.9745e-01 (6.30e-02) -	7.1102e-01 (2.31e-03) -	6.0729e-01 (2.44e-01) -	3.3755e-01 (8.38e-02) -	5.5523e-01 (3.12e-02) -	7.1998e-01 (1.36e-04) +	7.1996e-01 (1.11e-04)
B17-P8-T1	0 (0) =	0 (0) =	1.4787e-01 (2.59e-01) +	3.0104e-03 (1.48e-02) -	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B17-P8-T2	7.1102e-02 (9.99e-02) -	3.2384e-02 (8.28e-02) -	6.0310e-03 (3.30e-02) -	2.6798e-01 (1.44e-01) -	3.8778e-01 (1.26e-01) -	3.1013e-01 (1.50e-01) -	2.9280e-01 (1.32e-01) -	3.0191e-01 (1.01e-01) -	4.1856e-01 (8.99e-01) -	4.4342e-01 (1.64e-04)	
B17-P9-T1	2.5856e-02 (6.32e-02) -	1.0113e-02 (3.31e-02) -	5.2336e-01 (2.44e-02) +	4.6050e-01 (4.25e-02) -	1.4433e-01 (9.93e-02) -	5.1665e-01 (0) -	1.9653e-01 (1.55e-01) -	7.1966e-03 (1.73e-02) -	5.3460e-01 (2.28e-02) +	3.9204e-01 (1.78e-01)	
B17-P9-T2	0 (0) =	0 (0) =	0 (0) =	5.6685e-03 (3.10e-02) -	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	1.4890e-01 (8.11e-02)	
B19-P1-T1	9.9977e-01 (3.08e-07) +	9.9987e-01 (9.72e-05) -	9.9977e-01 (2.28e-06) -	9.9698e-01 (3.30e-03) -	9.9977e-01 (5.11e-07) -	9.9941e-01 (1.50e-03) -	9.9817e-01 (3.27e-03) -	9.9997e-01 (6.32e-07) +	9.9997e-01 (4.32e-07) +	9.9997e-01 (3.85e-07) +	9.9997e-01 (5.09e-06)
B19-P1-T2	9.9436e-01 (3.95e-03) -	9.9485e-01 (3.60e-03) -	9.9375e-01 (2.57e-03) -	9.8949e-01 (3.52e-03) -	9.9969e-01 (1.80e-04) -	9.9928e-01 (1.07e-03) -	9.9974e-01 (6.70e-04) +	9.9978e-01 (2.46e-04) +	9.9977e-01 (2.19e-05) +	9.9964e-01 (5.89e-04) -	9.9952e-01 (7.16e-04)
B19-P2-T1	8.7056e-01 (2.44e-02) -	8.6420e-01 (6.06e-03) -	8.7205e-01 (5.97e-04) +	8.7186e-01 (4.36e-04) -	8.7004e-01 (3.02e-04) -	8.6914e-01 (3.27e-04) -	8.6327e-01 (8.70e-03) -	8.6974e-01 (3.49e-04) -	8.6929e-01 (6.25e-04) -	8.6928e-01 (3.73e-04) -	8.7188e-01 (9.06e-05)
B19-P2-T2	9.4739e-01 (2.12e-02) -	9.2388e-01 (2.94e-02) -	9.0977e-01 (5.37e-02) -	8.7134e-01 (6.71e-03) -	8.8873e-01 (1.23e-04) +	9.8121e-01 (2.66e-03) -	9.7097e-01 (9.22e-03) -	9.8860e-01 (1.87e-04) -	9.8840e-01 (2.16e-04) -	9.7005e-01 (7.28e-03) -	9.8750e-01 (9.75e-04)
B19-P3-T1	6.3111e-01 (1.81e-01) -	6.1320e-01 (1.05e-01) -	6.4762e-01 (8.90e-02) -	4.7352e-01 (1.28e-01) -	7.4504e-01 (4.40e-02) -	6.6826e-01 (7.60e-02) -	5.2186e-01 (2.74e-02) -	7.4830e-01 (5.41e-02) +	6.8104e-01 (1.14e-01) -	6.8284e-01 (0.77e-02) -	7.4605e-01 (5.82e-02)
B19-P3-T2	8.5783e-01 (6.19e-03) -	7.8366e-01 (6.34e-02) -	7.5603e-01 (3.87e-02) -	7.0309e-01 (7.73e-02) -	8.5753e-01 (3.75e-03) -	8.1419e-01 (5.43e-02) -	8.3460e-01 (7.26e-03) -	8.0925e-01 (4.20e-02) -	8.2614e-01 (4.57e-02) -	8.3701e-01 (7.10e-03) -	8.7317e-01 (5.26e-03)
B19-P4-T1	8.1742e-01 (1.42e-02) -	7.7154e-01 (1.45e-01) -	7.4824e-01 (7.82e-02) -	7.3811e-01 (1.15e-01) -	8.2130e-01 (1.10e-01) -	8.0136e-01 (1.28e-01) -	8.8104e-01 (9.85e-02) +	8.2465e-01 (1.87e-01) +	8.0166e-01 (1.01e-01) -	8.3733e-01 (3.01e-02) -	7.6382e-01 (3.01e-02)
B19-P4-T2	9.4792e-01 (2.66e-02) -	9.3991e-01 (2.85e-02) -	9.3445e-01 (2.15e-02) -	9.2980e-01 (2.13e-02) -	9.5171e-01 (2.86e-02) -	9.4592e-01 (2.91e-02) -	9.4939e-01 (3.77e-02) -	9.5559e-01 (2.25e-02) +	9.3868e-01 (2.82e-02) -	9.3977e-01 (1.98e-02) -	9.3565e-01 (6.37e-03)
B19-P5-T1	7.6094e-01 (2.18e-02) -	7.5800e-01 (2.42e-02) -	7.5208e-01 (4.74e-02) -	7.0274e-01 (4.80e-02) -	7.6925e-01 (1.99e-02) -	6.0554e-01 (8.65e-03) -	7.3708e-01 (2.32e-02) -	7.6725e-01 (1.93e-02) -	7.7579e-01 (1.67e-02) -	7.7870e-01 (6.67e-03) -	8.0124e-01 (5.29e-03)
B19-P5-T2	9.8404e-01 (1.79e-02) -	9.6453e-01 (6.15e-02) -	9.7804e-01 (1.28e-02) -	9.3328e-01 (6.21e-02) -	9.5148e-01 (7.82e-02) -	9.9060e-01 (3.64e-04) +	8.7951e-01 (8.47e-02) -	9.3215e-01 (5.34e-02) -	9.8913e-01 (1.76e-03) -	9.8955e-01 (1.51e-03)	
B19-P6-T1	9.9344e-01 (2.75e-03) -	9.9199e-01 (2.77e-03) -	9.8850e-01 (1.76e-03) -	9.8638e-01 (1.57e-03) -	9.9432e-01 (3.33e-03) -	9.9348e-01 (3.84e-03) -	9.8290e-01 (7.74e-03) -	9.9192e-01 (4.24e-03) -	9.9305e-01 (3.86e-03) -	9.9442e-01 (4.66e-03) +	9.9374e-01 (3.55e-03)
B19-P6-T2	6.9540e-02 (5.97e-02) -	1.7318e-01 (4.23e-02) -	1.8015e-01 (2.50e-02) -	1.6161e-01 (2.77e-02) -	1.2276e-01 (4.58e-02) -	2.4608e-01 (5.61e-02) +	2.3657e-01 (7.20e-02) -	8.5044e-02 (4.44e-02) -	1.0105e-01 (5.60e-02) -	1.3926e-01 (8.15e-02) -	2.1754e-01 (3.19e-02)
B19-P7-T1	9.9751e-01 (3.54e-03) -	9.9578e-01 (2.48e-03) -	9.9527e-01 (2.76e-03) -	9.9227e-01 (1.60e-03) -	9.9338e-01 (1.77e-03) -	9.9853e-01 (2.25e-03) -	9.9829e-01 (2.53e-03) -	9.9707e-01 (1.84e-03) -	9.9926e-01 (1.97e-03) -	9.9830e-01 (2.32e-03) -	9.9922e-01 (7.54e-05)
B19-P7-T2	9.9856e-01 (1.63e-03) -	9.9807e-01 (1.04e-03) -	9.9641e-01 (2.25e-03) -	9.9462e-01 (1.26e-03) -	9.9906e-01 (1.23e-03) -	9.9857e-01 (1.64e-03) -	9.9882e-01 (2.07e-03) -	9.9917e-01 (3.86e-04) -	9.9900e-01 (1.42e-03) -	9.9896e-01 (1.94e-04) -	9.9972e-01 (1.49e-04)
B19-P8-T1	6.9968e-01 (3.59e-02) -	9.5778e-01 (4.63e-02) -	9.1279e-01 (5.37e-02) -	9.6570e-01 (3.57e-02) -	9.4682e-01 (4.83e-02) -	0 (0) -	9.7347e-01 (3.01e-02) -	9.4579e-01 (5.87e-02) -	9.8837e-01 (2.45e-03) -	9.8984e-01 (1.97e-03)	
B19-P8-T2	8.9976e-01 (7.12e-02) -	8.6171e-01 (7.88e-02) -	8.4531e-01 (5.69e-02) -	7.6211e-01 (3.60e-02) -	9.3908e-01 (3.55e-02) -	8.5918e-01 (5.88e-02) -	9.6029e-01 (9.76e-03) -	9.9424e-01 (4.99e-02) -	9.8515e-01 (6.76e-02) -	9.5698e-01 (1.07e-02) -	9.7690e-01 (3.40e-02)
B19-P9-T1	9.6070e-01 (2.77e-02) -	9.9975e-01 (4.52e-04) -	9.9961e-01 (3.04e-04) -	9.8775e-01 (2.60e-02) -	9.9954e-01 (4.51e-04) -	7.6015e-01 (1.87e-01) -	9.9412e-01 (8.42e-02) -	1.0000e+00 (1.40e-05) -	1.0000e+00 (1.40e-05) -	9.9992e-01 (4.33e-04) -	
B19-P9-T2	1.5681e-01 (5.78e-02) -	1.9329e-01 (4.36e-02) -	1.8894e-01 (2.78e-02) -	1.5002e-01 (3.33e-02) -	2.0228e-01 (5.82e-02) -	2.2793e-01 (8.48e-02) -	1.0860e-01 (4.83e-02) -	1.1889e-01 (5.01e-02) -	1.3319e-01 (6.07e-02) -	3.1191e-01 (6.10e-02)	
B19-P10-T1	6.5888e-01 (3.62e-02) -	5.9341e-01 (3.07e-02) -	6.3783e-01 (1.57e-01) -	4.9185e-01 (1.90e-02) -	6.4114e-01 (5.06e-02) -	5.7120e-01 (5.06e-02) -	2.4357e-01 (3.14e-02) -	5.4696e-01 (1.84e-02) -	6.1941e-01 (4.42e-02) -	5.0923e-01 (1.59e-01) -	7.5292e-01 (3.84e-03)
B19-P10-T2	8.4996e-01 (7.11e-02) -	8.1525e-01 (8.35e-02) -	8.6779e-01 (5.80e-02) -	8.3797e-01 (5.29e-02) -	8.4702e-01 (8.75e-02) -	8.3057e-01 (9.93e-02) -	9.1205e-01 (2.90e-02) -	8.4291e-01 (6.95e-02) -	8.3212e-01 (7.12e-02) -	9.3252e-01 (2.38e-02) +	8.7552e-01 (4.27e-02)
B21-P1-T1	0 (0) =	0 (0) =	6.7771e-01 (1.06e-01) +	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P1-T2	9.9470e-01 (2.78e-03) +	9.9465e-01 (2.53e-03) +	9.9670e-01 (1.70e-03) +	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P2-T1	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P3-T1	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -	0 (0) -
B21-P3-T2	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P4-T1	0 (0) =	0 (0) =	8.9504e-04 (4.90e-03) =	0 (0) =	0 (0) =	2.6860e-04 (1.02e-03) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P4-T2											

TABLE S-VI
AVERAGE IGD+ VALUES FOR COMPARISON ON MULTIOBJECTIVE MANY-TASK BENCHMARK SUITE.

	SPEA2	NSGA-III	MOEA/D-DE	LMOCSO	MO-MFEA	MOMFPA-SADE	EMT-ET	EMT-PD	MO-SBO	MO-MtIDE	MTEA-DCK
B21-MtTP1-T1	1.0466e+03 (3.07e+03)	1.1535e+03 (3.84e+03)	-	1.7722e+02 (1.17e+02)	3.3683e+01 (1.13e+01)	2.2404e+03 (1.26e+02)	3.2222e+02 (8.49e+00)	1.8690e+01 (4.02e+00)	-4.4618e+02 (1.84e+03)	2.9746e+02 (5.36e+01)	5.1572e-03 (1.96e-03)
B21-MtTP1-T2	1.7129e+03 (3.82e+03)	9.3433e+02 (2.54e+03)	1.9305e+02 (1.19e+02)	1.5374e+02 (2.41e+00)	3.2016e+01 (8.86e+00)	2.7772e+01 (1.71e+02)	3.0501e+01 (6.60e+00)	1.8596e+01 (3.70e+00)	5.2371e+02 (1.84e+03)	2.9991e+02 (6.46e+01)	5.2828e-03 (1.28e-03)
B21-MtTP1-T3	1.0491e+03 (4.04e+03)	8.4418e+02 (2.55e+03)	1.7934e+02 (1.22e+02)	1.1246e+01 (1.63e+00)	3.0894e+01 (8.84e+00)	2.3496e+03 (1.55e+02)	3.4045e+01 (1.17e+01)	1.9756e+01 (6.03e+00)	5.1857e+02 (1.84e+03)	3.1699e+02 (7.09e+01)	5.6640e-03 (1.58e-03)
B21-MtTP1-T5	1.7816e+03 (4.63e+03)	1.7191e+03 (3.48e+03)	2.1634e+02 (1.14e+02)	9.9185e+01 (1.20e+00)	3.0674e+01 (6.78e+00)	2.6922e+01 (1.55e+02)	3.3324e+01 (9.32e+00)	2.1100e+01 (6.07e+00)	5.5337e+02 (1.87e+03)	3.5292e+02 (9.72e+01)	5.4015e-03 (1.56e-03)
B21-MtTP1-T7	5.6236e+02 (2.02e+03)	1.0008e+01 (2.67e+03)	2.4835e+02 (2.11e+02)	1.1806e+00 (2.23e+00)	2.9398e+01 (8.26e+00)	2.3303e+01 (1.54e+02)	3.2224e+01 (9.79e+00)	1.6867e+01 (5.90e+00)	5.2155e+02 (1.87e+03)	2.5134e+02 (6.53e+01)	5.3080e-03 (1.62e-03)
B21-MtTP1-T8	1.7158e+03 (3.83e+03)	1.5560e+02 (4.04e+03)	1.8672e+02 (1.24e+02)	9.7268e+01 (1.28e+00)	2.3290e+01 (1.18e+00)	3.1128e+02 (2.11e+00)	3.3967e+01 (8.52e+00)	2.0235e+01 (4.30e+00)	5.3257e+02 (1.85e+03)	4.3109e+02 (1.03e+02)	5.8521e-03 (2.36e-03)
B21-MtTP1-T9	1.3776e+04 (3.48e+03)	5.1468e+02 (1.85e+03)	2.0782e+02 (1.38e+02)	1.3988e+00 (1.58e+00)	3.2429e+01 (7.32e+00)	2.0209e+01 (1.36e+02)	3.1528e+01 (7.23e+00)	1.8020e+01 (4.57e+00)	5.1517e+02 (1.85e+03)	2.5347e+02 (6.28e+01)	6.2583e-03 (2.17e-03)
B21-MtTP1-T10	1.0386e+03 (3.08e+03)	6.4755e+02 (1.94e+03)	2.0156e+00 (2.25e+00)	3.6244e+01 (9.93e+00)	7.2977e+01 (6.29e-04)	3.2639e+01 (8.47e+00)	1.9388e+01 (5.56e+00)	5.1190e+02 (1.85e+03)	2.9834e+02 (7.44e+01)	5.8024e-03 (2.31e-03)	
B21-MtTP2-T1	1.0291e+03 (7.82e+02)	1.0759e+03 (8.62e+02)	1.1859e+03 (3.24e+02)	5.1063e+02 (8.07e+01)	8.3922e+02 (4.44e+02)	1.1070e+03 (3.63e+01)	6.7375e+02 (6.75e+01)	6.1927e+02 (8.00e+01)	6.9976e+02 (9.66e+01)	3.9410e+02 (7.13e+01)	1.8053e-02 (4.98e-01)
B21-MtTP2-T2	1.1235e+03 (1.08e+03)	1.0366e+03 (7.98e+02)	1.4755e+02 (2.82e+02)	4.8722e+02 (6.16e+01)	8.3854e+02 (4.42e+02)	1.0299e+03 (4.29e+01)	6.8000e+02 (8.15e+01)	5.8242e+02 (8.32e+01)	7.3699e+02 (1.21e+02)	3.6281e+02 (4.97e+01)	3.1610e-02 (3.16e+00)
B21-MtTP2-T3	1.2053e+03 (9.36e+02)	8.5773e+02 (4.58e+02)	1.1309e+01 (2.58e+02)	5.0000e+02 (5.45e+01)	8.6274e+02 (4.39e+02)	7.0472e+02 (9.21e+01)	6.1383e+01 (7.64e+01)	7.6693e+02 (1.33e+02)	3.9212e+02 (7.48e+01)	1.8518e-02 (3.82e+01)	
B21-MtTP2-T4	8.6670e+02 (4.65e+02)	9.7643e+02 (6.24e+02)	1.1595e+02 (2.86e+02)	4.7409e+02 (5.97e+01)	8.6704e+02 (4.51e+02)	1.0850e+03 (3.64e+01)	6.8209e+02 (6.72e+01)	1.0180e+02 (8.46e+01)	7.4177e+02 (1.24e+02)	3.8448e+02 (4.88e+01)	1.8452e-02 (4.66e+01)
B21-MtTP2-T5	1.0105e+03 (7.68e+02)	9.9472e+02 (7.43e+02)	1.2375e+03 (2.91e+02)	4.8310e+02 (4.92e+01)	8.7534e+02 (4.58e+02)	9.4396e+02 (3.12e+01)	6.8021e+02 (8.96e+01)	6.0481e+02 (7.98e+01)	7.6324e+02 (1.32e+02)	3.6097e+02 (6.03e+01)	1.7355e-02 (4.77e+01)
B21-MtTP2-T6	9.3544e+02 (6.28e+02)	9.2661e+02 (6.39e+02)	1.1834e+03 (3.13e+02)	4.7844e+02 (6.14e+01)	8.1184e+02 (4.05e+02)	1.0754e+02 (9.56e+01)	6.2815e+02 (8.64e+01)	7.3049e+02 (1.29e+02)	4.1836e+02 (6.65e+01)	1.9425e-02 (3.54e+01)	
B21-MtTP2-T7	8.4851e+02 (4.63e+02)	1.0709e+03 (8.58e+02)	1.2075e+02 (2.16e+02)	4.9556e+02 (8.91e+01)	8.3305e+02 (4.64e+02)	1.0091e+03 (3.62e+01)	6.6932e+02 (1.02e+02)	6.2537e+02 (7.47e+01)	7.5439e+02 (1.45e+02)	3.8461e+02 (5.68e+01)	1.7829e-02 (3.82e+01)
B21-MtTP2-T8	9.9975e+02 (7.25e+02)	1.0825e+03 (8.71e+02)	1.1776e+02 (2.82e+02)	4.9015e+02 (7.02e+01)	8.3471e+02 (4.47e+02)	1.2343e+03 (5.11e+01)	6.8262e+02 (8.26e+01)	7.6275e+02 (1.76e+01)	4.1782e+02 (7.94e+01)	4.0332e+02 (7.14e+01)	1.8802e+02 (3.96e+01)
B21-MtTP2-T9	4.9056e+02 (6.16e+02)	1.0888e+03 (1.09e+03)	1.2282e+03 (2.09e+02)	5.0408e+02 (8.40e+01)	8.5366e+02 (4.74e+02)	1.1350e+03 (3.88e+01)	6.6355e+02 (1.05e+02)	6.0440e+02 (7.02e+01)	7.2109e+02 (8.82e+01)	3.7415e+02 (5.78e+01)	1.8160e+02 (4.03e+01)
B21-MtTP2-T10	1.0693e+03 (7.40e+02)	1.1065e+03 (7.92e+02)	1.2585e+03 (2.98e+02)	4.9010e+02 (7.53e+01)	8.5426e+02 (4.52e+02)	3.9156e+02 (1.50e+01)	6.9600e+02 (8.30e+01)	7.4329e+02 (1.07e+02)	4.3531e+02 (8.57e+01)	1.59190e+02 (1.85e+03)	5.8024e-03 (2.31e-03)
B21-MtTP3-T1	1.1161e+00 (4.60e+01)	1.1806e+00 (4.57e+01)	9.8814e+01 (1.14e+01)	6.2178e+01 (6.30e-02)	1.1407e+00 (4.58e+01)	1.8161e+00 (4.29e+00)	1.3950e+00 (4.15e+01)	1.0208e+00 (1.80e+02)	1.1628e+00 (4.59e+01)	1.0967e+00 (2.17e+02)	1.9562e-03 (8.05e-03)
B21-MtTP3-T2	1.3930e+02 (8.72e-01)	1.4398e+02 (8.68e-01)	9.8200e+01 (1.01e+01)	6.7113e+01 (1.46e+01)	1.1405e+00 (4.59e-01)	1.7554e+00 (3.07e+00)	1.0324e+00 (1.99e-01)	1.0189e+00 (3.08e-01)	1.1964e+00 (4.58e+01)	1.1035e+00 (2.04e-02)	2.2249e-02 (1.09e-02)
B21-MtTP3-T3	1.1235e+03 (1.08e+03)	1.0366e+03 (7.98e+02)	1.4755e+02 (2.82e+02)	4.8722e+02 (6.16e+01)	8.1184e+02 (4.42e+02)	1.0744e+02 (9.17e+01)	6.8000e+02 (8.15e+01)	5.8242e+02 (8.32e+01)	7.3699e+02 (1.21e+02)	3.6281e+02 (4.97e+01)	1.5230e-02 (3.16e+00)
B21-MtTP3-T4	1.2053e+03 (9.36e+02)	8.5773e+02 (4.58e+02)	1.1309e+01 (2.58e+02)	5.0000e+02 (5.45e+01)	8.6274e+02 (4.39e+02)	7.0472e+02 (9.21e+01)	6.1383e+01 (7.64e+01)	7.6693e+02 (1.33e+02)	3.9212e+02 (7.48e+01)	1.8518e-02 (3.82e+01)	
B21-MtTP3-T5	8.6670e+02 (4.65e+02)	8.7643e+02 (6.24e+02)	1.1595e+02 (2.86e+02)	4.7409e+02 (5.97e+01)	8.6704e+02 (4.51e+02)	1.0850e+03 (3.64e+01)	6.8209e+02 (8.64e+01)	7.1080e+02 (1.26e+01)	4.1717e+02 (7.62e+01)	3.8448e+02 (4.88e+01)	1.8452e-02 (4.66e+01)
B21-MtTP3-T6	1.0105e+03 (7.68e+02)	9.9472e+02 (7.43e+02)	1.2375e+03 (2.91e+02)	4.8310e+02 (4.92e+01)	8.7534e+02 (4.58e+02)	9.4396e+02 (3.12e+01)	6.8021e+02 (8.96e+01)	6.0481e+02 (7.98e+01)	7.6324e+02 (1.32e+02)	3.6097e+02 (6.03e+01)	1.7355e-02 (4.77e+01)
B21-MtTP3-T7	9.3544e+02 (6.28e+02)	9.2661e+02 (6.39e+02)	1.1834e+03 (3.13e+02)	4.7844e+02 (6.14e+01)	8.1184e+02 (4.05e+02)	1.0754e+02 (9.56e+01)	6.2815e+02 (8.64e+01)	7.3049e+02 (1.29e+02)	4.1836e+02 (6.65e+01)	3.9843e+02 (7.44e+01)	1.9425e-02 (3.54e+01)
B21-MtTP3-T8	8.4851e+02 (4.63e+02)	1.0724e+01 (6.34e+01)	1.2421e+01 (2.06e+02)	4.9556e+02 (8.91e+01)	8.3305e+02 (4.64e+02)	1.0208e+01 (1.70e+02)	6.1059e+02 (1.02e+02)	5.0159e+02 (2.03e+02)	7.0452e+02 (1.26e+02)	3.6097e+02 (6.03e+01)	1.8430e-02 (4.62e+01)
B21-MtTP3-T9	9.9975e+02 (7.25e+02)	1.0825e+03 (8.71e+02)	1.1776e+02 (2.82e+02)	4.9015e+02 (7.02e+01)	8.3471e+02 (4.47e+02)	1.2343e+03 (5.11e+01)	6.8262e+02 (8.26e+01)	7.6275e+02 (1.76e+01)	4.1782e+02 (7.94e+01)	4.0332e+02 (7.14e+01)	1.8802e+02 (3.96e+01)
B21-MtTP3-T10	1.0465e+03 (7.40e+02)	1.1065e+03 (7.92e+02)	1.2585e+03 (2.98e+02)	4.9010e+02 (7.53e+01)	8.5426e+02 (4.52e+02)	3.9156e+02 (1.50e+01)	6.9600e+02 (8.30e+01)	7.4329e+02 (1.07e+02)	4.3531e+02 (8.57e+01)	1.59190e+02 (1.85e+03)	5.8024e-03 (2.31e-03)
B21-MtTP4-T1	1.1161e+00 (4.60e+01)	1.1806e+00 (4.57e+01)	9.8814e+01 (1.14e+01)	6.2178e+01 (6.30e-02)	1.1407e+00 (4.58e+01)	1.8161e+00 (4.29e+00)	1.3950e+00 (4.15e+01)	1.0208e+00 (1.80e+02)	1.1628e+00 (4.59e+01)	1.0967e+00 (2.17e+02)	1.9562e-03 (8.05e-03)
B21-MtTP4-T2	1.3930e+02 (8.68e-01)	1.4398e+02 (8.68e-01)	9.8200e+01 (1.01e+01)	6.7113e+01 (1.46e+01)	1.1405e+00 (4.59e-01)	1.7554e+00 (3.07e+00)	1.0324e+00 (1.99e-01)	1.0189e+00 (3.08e-01)	1.1964e+00 (4.58e+01)	1.1035e+00 (2.04e-02)	2.2249e-02 (1.09e-02)
B21-MtTP4-T3	1.3930e+02 (8.68e-01)	1.4398e+02 (8.68e-01)	9.8200e+01 (1.01e+01)	6.7113e+01 (1.46e+01)	1.1405e+00 (4.59e-01)	1.7554e+00 (3.07e+00)	1.0324e+00 (1.99e-01)	1.0189e+00 (3.08e-01)	1.1964e+00 (4.58e+01)	1.1035e+00 (2.04e-02)	2.0745e-02 (3.63e-03)
B21-MtTP4-T4	1.2053e+03 (9.36e-01)	1.2421e+01 (5.71e-01)	1.0900e+01 (1.01e-01)	6.9407e+01 (1.35e-01)	1.2174e+01 (2.06e-01)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.70e-02)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.8043e-02 (6.31e-03)
B21-MtTP4-T5	1.4454e+03 (1.45e-01)	1.2375e+03 (1.76e-01)	1.2404e+02 (2.74e+00)	4.1597e+03 (1.78e-01)	1.2375e+03 (1.76e-01)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.0304e+00 (1.80e-02)	1.8043e-02 (6.31e-03)
B21-MtTP4-T6	1.8172e+00 (1.26e-01)	1.8846e+00 (1.47e-01)	1.3281e+00 (1.60e-01)	5.1060e+00 (1.36e-01)	1.5308e+00 (2.16e-01)	1.0208e+00 (1.25e-02)	1.1106e+00 (7.92e-02)	1.9157e+00 (1.02e+00)	1.2204e+00 (1.55e-01)	1.6160e+00 (1.19e-02)	2.8387e-02 (9.61e-03)
B21-MtTP4-T7	5.6342e+01 (4.94e-01)	5.3435e+01 (4.94e-01)	5.1991e+01 (5.86e-01)	4.0704e+01 (4.45e-01)	5.1696e+01 (5.91e-01)	4.0326e+01 (5.23e-01)	5.0159e+01 (5.05e-01)	4.0326e+01 (5.23e-01)	5.0159e+01 (5.05e-01)	4.0326e+01 (5.23e-01)	2.0598e-01 (6.96e-01)
B21-MtTP4-T8	5.6344e+01 (4.94e-01)	5.3435e+01 (4.94e-01)	5.1990e+01 (5.86e-01)	4.0704e+01 (4.45e-01)	5.1696e+01 (5.91e-01)	4.0326e+01 (5.23e-01)	5.0159e+01 (5.05e-01)	4.0326e+01 (5.23e-01)	5.0159e+01 (5.05e-01)	4.0326e+01 (5.23e-01)	2.0598e-01 (6.96e-01)
B21-MtTP4-T9	2.0316e+00 (4.07e-01)	2.0736e+00 (4.07e-01)	1.7272e+00 (4.07e-01)	1.2064e+00 (4.07e-01)	2.0736e+00 (4.07e-01)	1.0208e+00 (1.25e-02)	2.0598e+00 (8.29e-02)	2.1558e+00 (8.29e-02)	2.0651e+00 (1.04e-01)	2.4604e+00 (9.66e-01)	2.8036e-01 (8.30e-03)
B21-MtTP4-T10	1.2172e+00 (4.76e-01)	1.2074e+00 (4.64e-01)	1.2074e+00 (4.64e-01)	2.0598e-01 (6.96e-01)							
B21-MtTP5-T1	1.2852e+03 (9.16e-03)	1.2949e+03 (9.16e-03)	1.6627e+03 (3.19e-02)	2.2374e+03 (8.73e-02)	5.9838e+03 (4.29e-						

TABLE S-VII

AVERAGE HV VALUES FOR COMPARISON ON MULTIOBJECTIVE MANY-TASK BENCHMARK SUITE.

TABLE S-VIII
AVERAGE IGD+ VALUES FOR COMPONENT ANALYSIS.

	All-DKT	All-CKT-S	Invert-KT	W/O-DKT	W/O-DKT-A	W/O-DKT-R	W/O-CKT	W/O-CKT-C	W/O-CKT-S	All-DE	All-CSO	MTEA-DCK
B17-P1-T1	0.2038e-03 (1.57e-04) =	1.8789e-03 (4.25e-04) =	1.9116e-03 (3.98e-05) =	1.8991e-03 (5.43e-05) =	1.9216e-03 (6.70e-05) =	1.9155e-03 (4.81e-05) =	2.1065e-03 (2.06e-04) =	1.8777e-03 (5.11e-05) +	1.9092e-03 (5.43e-05) =	1.9693e-03 (6.31e-05) =	1.8192e+00 (2.37e+00) =	1.9098e-03 (4.50e-05)
B17-P1-T2	5.6758e-03 (1.92e-03) =	3.3637e-03 (4.28e-04) =	3.7483e-03 (3.58e-04) =	3.9263e-03 (6.88e-04) =	3.8090e-03 (6.11e-04) =	3.3805e-03 (2.20e-04) +	5.3527e-03 (3.56e-03) =	3.8119e-03 (3.08e-04) =	3.4839e-03 (3.83e-04) =	3.3902e-03 (3.44e-04) =	7.0181e-01 (2.66e-01) =	3.4199e-03 (3.78e-04)
B17-P2-T1	2.4942e-03 (7.75e-05) =	2.4310e-03 (6.30e-05) =	2.4591e-03 (9.76e-05) =	2.4358e-03 (6.93e-05) =	2.4415e-03 (6.55e-05) =	2.4733e-03 (9.55e-05) =	2.4767e-03 (4.87e-05) =	2.3964e-03 (5.62e-05) +	2.4648e-03 (7.65e-05) =	2.4827e-03 (7.17e-05) =	2.7390e-03 (4.24e-02) =	2.4806e-03 (7.63e-05)
B17-P2-T2	2.6101e-03 (2.59e-03) =	2.0291e-03 (5.98e-05) =	2.0923e-03 (7.36e-05) =	2.0515e-03 (7.91e-05) =	2.0124e-03 (6.72e-05) +	2.0572e-03 (7.92e-05) =	2.0730e-03 (9.17e-05) =	2.2167e-03 (7.21e-05) =	2.0476e-03 (7.65e-05) =	2.1907e-03 (1.54e-04) =	2.5805e-03 (2.48e-04) =	2.0619e-03 (8.42e-05)
B17-P3-T1	1.5925e+00 (6.96e+00) =	1.9544e-03 (5.51e-05) =	1.9857e-03 (5.17e-05) =	1.9746e-03 (6.73e-05) =	1.9656e-03 (5.24e-05) =	1.9446e-03 (4.83e-05) +	1.6089e+00 (5.86e+00) =	2.0764e-03 (5.49e-05) =	1.9613e-03 (5.22e-05) =	1.2339e+01 (4.98e+00) =	8.3614e+00 (4.39e+01) =	1.9475e-03 (5.43e-05)
B17-P3-T2	4.0543e-03 (2.77e-04) =	3.9119e-03 (1.46e-04) =	3.6407e-03 (1.90e-04) =	3.1982e-03 (1.20e-04) =	3.2626e-03 (1.73e-04) =	3.4818e-03 (1.66e-04) =	3.8894e-03 (2.07e-04) =	3.1199e-03 (1.26e-04) +	3.4823e-03 (1.76e-04) =	3.6688e-03 (1.98e-04) =	1.1375e-03 (2.50e-03) =	3.0422e-03 (1.99e-04)
B17-P4-T1	4.7428e-02 (1.68e-01) =	4.5958e-01 (3.07e-01) =	3.1770e-03 (3.06e-04) =	6.2240e-01 (1.68e-01) =	2.6598e-02 (1.21e-01) =	3.4531e-03 (6.73e-04) =	3.5747e-03 (5.42e-04) =	3.1838e-03 (3.11e-04) =	3.2993e-03 (4.48e-04) =	1.4493e-01 (2.65e-01) =	3.1956e+01 (1.33e+01) =	3.1658e-03 (3.61e-04) +
B17-P4-T2	1.6467e+01 (6.00e+00) =	2.3623e+00 (1.60e+00) =	1.2023e+00 (1.83e+00) +	1.1940e+01 (2.01e+01) =	5.0863e+00 (9.80e+00) =	5.1702e+00 (8.06e+00) =	4.9861e+00 (6.54e+00) =	4.1309e+00 (5.26e+00) =	4.1309e+00 (5.26e+00) =	6.1938e+00 (2.63e+00) =	1.5863e+00 (3.45e+00) =	2.8616e+00 (4.46e+00)
B17-P5-T1	4.5311e-03 (1.61e-02) =	3.7911e-02 (1.52e-02) =	3.8592e-02 (1.54e-02) =	4.5366e-02 (2.08e-02) =	3.3203e-02 (1.24e-02) =	3.2901e-02 (1.33e-02) +	4.7229e-02 (1.98e-02) =	3.4488e-02 (1.13e-02) =	3.5103e-02 (1.25e-02) =	6.6014e-02 (1.91e-02) =	1.7826e+00 (2.01e+00) =	3.3116e-02 (1.29e-02)
B17-P5-T2	2.0901e+02 (1.19e-02) =	2.1525e+02 (9.26e+01) =	2.1092e+02 (9.34e+01) =	2.0300e+02 (1.00e+02) =	1.9197e+02 (6.49e+01) +	2.0500e+02 (8.88e+01) =	2.0575e+02 (5.80e+01) =	2.1525e+02 (7.70e+01) =	2.7789e+02 (1.14e+02) =	4.5556e+02 (1.48e+02) =	2.0725e+02 (8.10e+01) =	1.9196e-02 (3.05e-02)
B17-P6-T1	4.7396e-03 (5.27e-03) +	7.5289e-03 (7.78e-03) =	4.9467e-03 (4.96e-03) =	5.7091e-03 (5.82e-03) =	9.5477e-03 (7.83e-03) =	7.9796e-03 (8.08e-03) =	8.7365e-03 (1.08e-02) =	5.7628e-03 (5.71e-03) =	7.0097e-03 (6.92e-03) =	5.5450e-03 (6.72e-03) =	1.0244e+00 (3.56e-02) =	5.1482e-03 (5.75e-03)
B17-P6-T2	1.3432e+00 (5.09e+00) =	2.0699e+00 (8.18e-01) =	9.0833e-03 (5.19e-03) =	3.0916e+00 (1.07e+00) =	1.0510e-02 (7.22e-03) =	2.4138e+00 (8.18e-02) =	2.0476e+00 (5.80e+00) =	1.8916e+00 (5.83e+00) +	2.9772e+00 (9.81e+00) =	4.9857e+00 (6.54e+00) =	6.1938e+00 (2.63e+00) =	1.0202e+00 (6.16e-01) =
B17-P7-T1	1.1933e+02 (1.36e+02) =	4.5055e+01 (6.14e-01) =	5.1571e+01 (5.57e-01) =	4.4732e+02 (1.12e+00) +	4.5147e+01 (6.32e-01) =	4.4929e+00 (5.28e-01) =	1.1192e+02 (8.89e-01) =	4.5012e+01 (6.13e-01) =	4.5122e+01 (5.04e-01) =	6.9670e+01 (9.87e-01) =	2.1395e+02 (4.75e+00) =	4.4905e+01 (4.53e-01)
B17-P7-T2	3.0266e-03 (1.50e-04) =	3.6334e-03 (2.87e-04) =	3.9156e-03 (5.09e-05) =	2.9777e-03 (1.16e-04) =	2.9032e-03 (1.09e-04) =	2.9147e-03 (1.13e-04) =	2.9017e-03 (1.09e-04) =	2.9853e-03 (1.50e-04) =	2.9285e-03 (8.40e-05) =	2.9190e-03 (0.93e-05) =	1.9861e+00 (2.94e+00) =	2.8867e-03 (7.35e-05) +
B17-P8-T1	1.4497e+01 (1.16e+01) =	1.4538e+01 (1.63e+00) =	1.4778e+01 (1.20e+00) =	1.4583e+01 (1.39e+00) =	1.4829e+01 (1.26e+00) =	1.4658e+01 (8.06e-01) =	1.6416e+01 (1.24e+00) =	1.4783e+01 (8.02e-01) =	1.4517e+01 (9.87e-01) =	1.4337e+01 (1.21e+00) +	1.4804e+00 (3.19e+00) =	1.4771e+00 (1.17e+00)
B17-P8-T2	3.0936e-03 (1.40e-03) =	2.5232e-02 (5.67e-02) =	3.6040e-03 (1.05e-03) =	4.7630e-02 (7.55e-02) =	3.4729e-03 (1.26e-03) =	3.2015e-03 (8.61e-03) =	8.6913e-03 (2.96e-02) =	3.2670e-03 (1.11e-03) =	3.0932e-03 (7.98e-04) +	4.5152e-02 (1.46e-01) =	2.5581e+00 (3.18e-01) =	3.2199e-03 (9.80e-04)
B17-P9-T1	1.4195e-01 (2.38e-01) =	6.2627e-02 (2.34e-02) =	5.1874e-02 (1.24e-02) =	4.5181e-02 (6.76e-03) =	1.2742e-01 (2.39e-01) =	3.3503e-02 (1.61e-01) =	1.1100e-01 (1.22e-01) =	3.7555e-02 (1.64e-00) =	1.1370e-01 (1.22e-01) =	2.5184e-01 (3.72e-01) =	3.6585e-02 (4.43e-03) +	1.6054e+00 (1.76e-01) =
B17-P9-T2	1.3618e+01 (9.76e+00) =	1.9786e+01 (3.21e+00) =	1.5154e+01 (8.84e+00) =	2.0387e+01 (4.94e-02) =	1.9047e+01 (5.18e+00) =	1.9780e+01 (3.72e+00) =	1.9060e+01 (5.18e+00) =	1.9883e+01 (6.21e+00) =	2.0383e+01 (3.72e+00) =	2.0383e+01 (3.72e+00) =	1.3156e+01 (2.57e+00) +	1.9721e+01 (3.72e+00) =
B17-P10-T1	3.5872e-03 (1.03e-04) =	3.5899e-03 (1.61e-04) =	3.6047e-03 (1.33e-04) =	3.5696e-03 (1.45e-04) =	3.5783e-03 (1.81e-04) =	3.5056e-03 (1.50e-04) =	3.5356e-03 (1.50e-04) =	3.5261e-03 (1.43e-04) +	3.5984e-03 (1.24e-04) =	3.5611e-03 (1.59e-04) =	8.6830e-03 (1.72e-03) =	3.5425e-03 (1.25e-04)
B17-P10-T2	1.8427e-02 (1.51e-02) =	1.5038e-02 (5.46e-02) =	1.8272e-02 (7.02e-03) =	1.4720e-02 (7.10e-03) =	1.4425e-02 (7.20e-03) =	1.3838e-02 (6.40e-03) =	6.8595e-02 (6.39e-02) =	1.6152e-02 (7.26e-03) =	1.1727e-02 (5.58e-03) +	8.1347e-02 (6.78e-02) =	6.0099e-02 (1.42e-02) =	1.3622e-02 (6.48e-03)
B17-P11-T1	3.6192e-03 (1.38e-04) =	3.5646e-03 (1.53e-04) =	3.5748e-03 (1.67e-04) =	3.5891e-03 (1.22e-04) =	3.5326e-03 (1.47e-04) =	3.4526e-03 (1.23e-04) +	3.5216e-03 (1.62e-04) =	3.4584e-03 (1.36e-04) =	3.5535e-03 (1.25e-04) =	3.5202e-03 (1.64e-02) =	1.4395e-02 (1.75e-04) =	3.5009e-03 (1.21e-04)
B17-P11-T2	4.5518e-03 (7.45e-04) =	3.6334e-03 (2.87e-04) =	3.9156e-03 (5.09e-05) =	3.5524e-03 (2.02e-04) +	3.6624e-03 (3.12e-04) =	3.6849e-03 (2.67e-04) =	5.2833e-03 (1.26e-03) =	3.6515e-03 (1.65e-04) =	3.6481e-03 (2.82e-04) =	9.6872e-03 (2.43e-04) =	2.0202e-03 (1.64e-02) =	3.7482e-03 (3.19e-04)
B17-P12-T1	1.2044e+01 (0.52e-02) =	5.7253e-02 (3.36e-02) =	6.0713e-02 (3.47e-02) =	7.3633e-02 (4.66e-02) =	5.6699e-02 (3.38e-02) =	5.8131e-02 (3.34e-02) =	1.1000e-01 (5.75e-02) =	4.9840e-02 (1.97e-02) +	6.3160e-02 (4.76e-02) =	9.1151e-02 (6.06e-02) =	1.7291e-01 (0.51e-02) =	2.5418e-02 (2.42e-02)
B17-P12-T2	2.4266e-02 (7.75e-02) =	1.8928e-02 (8.17e-02) =	2.5369e-02 (6.57e-02) =	2.0607e-02 (6.23e-02) =	2.2053e-02 (6.92e-02) =	1.7775e-02 (4.47e-02) +	1.9312e-02 (5.75e-02) =	2.0313e-02 (4.03e-03) =	1.8503e-02 (4.93e-03) =	4.5453e-02 (6.44e-03) =	1.7071e-02 (3.06e-03) +	2.5454e-02 (2.42e-03)
B17-P13-T1	1.7801e-03 (9.42e-03) =	1.6751e-03 (1.59e-02) =	1.6303e-03 (8.89e-03) =	1.6539e-03 (1.40e-02) =	1.6490e-03 (1.00e-02) =	1.7717e-03 (1.81e-02) =	1.6416e-03 (1.23e-02) =	1.2576e-03 (1.06e-02) +	1.8763e-03 (8.18e-03) =	1.9767e-03 (1.98e-03) =	1.2361e-03 (1.96e-03) =	1.9761e-03 (1.06e-03)
B17-P13-T2	1.0934e-03 (1.03e-03) =	1.0337e-03 (2.72e-02) =	1.3126e-03 (3.52e-02) =	1.0328e-03 (3.45e-02) +	1.0981e-03 (2.84e-02) =	1.0859e-03 (2.35e-02) =	2.3730e-03 (3.38e-02) =	1.4963e-03 (2.04e-02) =	2.3434e-03 (3.38e-02) =	2.3730e-03 (3.38e-02) =	2.3282e-03 (3.40e-02) =	1.8404e-03 (8.40e-03)
B17-P14-T1	2.7178e-04 (2.03e-04) =	2.0794e-04 (1.05e-04) +	2.3477e-04 (1.71e-04) =	2.0794e-04 (2.24e-04) =	2.0794e-04 (1.14e-04) =	2.0794e-04 (1.04e-04) =	2.0794e-04 (1.04e-04) =	2.3780e-04 (2.01e-04) +	2.2704e-04 (1.79e-04) =	2.3780e-04 (1.96e-04) =	2.3780e-04 (1.60e-04) =	2.3780e-04 (1.84e-04)
B17-P14-T2	2.2096e-04 (1.55e-04) =	1.9722e-04 (1.07e-04) =	1.7979e-04 (1.08e-04) +	2.3823e-04 (0.961e-03) =	2.1947e-04 (1.01e-04) =	2.4452e-04 (1.85e-04) =	2.4460e-04 (1.85e-04) =	2.3770e-04 (1.49e-04) +	2.8558e-04 (8.43e-04) =	2.6737e-04 (8.43e-04) =	2.5624e-04 (1.36e-04) =	2.5702e-04 (3.45e-04) +
B17-P15-T1	1.8513e-01 (4.87e-01) +	2.1735e-01 (4.78e-01) =	2.0226e-01 (4.72e-01) =	2.2978e-01 (1.17e-01) =	2.2106e-01 (1.49e-01) =	2.6671e-01 (1.59e-01) =	2.3917e-01 (1.18e-01) =	2.3744e-01 (1.17e-01) =	2.3744e-01 (1.17e-01) =	2.3744e-01 (1.17e-01) =	2.3744e-01 (1.17e-01) =	2.3744e-01 (1.17e-01) =
B17-P15-T2	1.8963e-01 (4.98e-01) =	2.2507e-01 (4.30e-01) =	1.9822e-01 (6.13e-01) +	2.0352e-01 (4.93e-01) =	2.2383e-01 (4.64e-01) =	2.4589e-01 (1.26e-01) =	2.6074e-01 (1.58e-01) =	2.3338e-01 (5.94e-01) =	2.3338e-01 (5.94e-01) =	2.3653e-01 (1.33e-01) =	2.4096e-01 (1.56e-01) =	2.4096e-01 (1.56e-01)
B17-P16-T1	2.4295e-02 (2.86e-02) =	4.2585e-02 (2.84e-02) =	4.2181e-02 (2.61e-02) =	4.0858e-02 (2.49e-02) =	4.1196e-02 (1.96e-02) =	4.1196e-02 (1.96e-02) =	4.2815e-02 (3.03e-02) =	4.3122e-02 (2.20e-02) +	4.0110e-02 (2.25e-02) =	3.6647e-02 (2.57e-02) =	5.0339e-02 (1.84e-02) =	3.8493e-02 (2.25e-02) =
B17-P16-T2	2.1950e-02 (8.24e-02) +	3.8790e-02 (1.14e-02) =	2.8467e-02 (9.43e-03) =	4.2156e-01 (1.46e-01) =	3.0352e-01 (1.08e-01) =	3.0926e-01 (1.16e-01) =	2.6070e-01 (9.48e-00) =	2.5918e-01 (9.17e-00) =	2.5715e-01 (6.78e-00) =	2.6215e-01 (1.74e-00) =	2.8777e-02 (1.92e-02) =	2.8508e-02 (1.76e-02)
B17-P17-T1	7.9273e-01 (5.87e-01) =	8.6621e-01 (5.93e-01) =	7.4463e-01 (5.53e-01) =	1.0466e-01 (5.06e-01) =	8.5989e-01 (4.17e-01) =	8.6740e-01 (5.54e-01) =	6.2550e-01 (5.95e-01) =	7.3769e-01 (7.00e-01) +	5.6628e-01 (5.70e-01) =	5.1612e-01 (5.16e-01) =		

TABLE S-IX
AVERAGE HV VALUES FOR COMPONENT ANALYSIS.

All-DKT	All-CKT	Invert-KT	W/O-DKT	W/O-DKT-A	W/O-DKT-R	W/O-CKT	W/O-CKT-C	W/O-CKT-S	All-DE	All-CSO	MTEA-DCK
B17-P1-T1	3.4703e-01 (2.52e-04)	-	3.4736e-01 (7.41e-05)	3.4731e-01 (7.32e-05)	3.4733e-01 (9.72e-05)	3.4729e-01 (1.17e-04)	3.4730e-01 (9.00e-05)	3.4699e-01 (3.24e-04)	3.4732e-01 (1.03e-04)	3.4731e-01 (9.49e-05)	3.4721e-01 (1.11e-04) -
B17-P1-T2	4.3967e-01 (4.43e-03)	-	4.4291e-01 (7.42e-04)	4.4274e-01 (6.17e-04)	4.4242e-01 (1.12e-03)	4.4263e-01 (1.04e-03)	4.4353e-01 (3.75e-04)	4.4025e-01 (5.52e-03)	4.4266e-01 (5.09e-04)	4.4319e-01 (6.33e-04)	4.4349e-01 (6.13e-04) -
B17-P2-T1	4.4472e-01 (1.28e-04)	-	4.4483e-01 (1.03e-04)	4.4478e-01 (1.58e-04)	4.4482e-01 (1.13e-04)	4.4481e-01 (1.05e-04)	4.4476e-01 (1.50e-04)	4.4477e-01 (7.72e-05)	4.4488e-01 (9.55e-05)	4.4477e-01 (1.22e-04)	4.4474e-01 (1.14e-04) -
B17-P2-T2	3.4629e-01 (3.68e-03)	-	3.4714e-01 (1.11e-04)	3.4703e-01 (1.22e-04)	3.4716e-01 (1.29e-04)	3.4717e-01 (1.12e-04)	3.4709e-01 (1.33e-04)	3.4707e-01 (1.16e-04)	3.4680e-01 (1.15e-04)	3.4710e-01 (1.22e-04)	3.4688e-01 (2.44e-04) -
B17-P3-T1	0 (0) -	-	3.4725e-01 (9.80e-05)	3.4720e-01 (9.31e-05)	3.4724e-01 (1.16e-04)	3.4727e-01 (8.75e-05)	0 (0) -	3.4704e-01 (1.00e-04)	3.4725e-01 (9.70e-05)	0 (0) -	1.1031e-02 (3.12e-02) -
B17-P3-T2	7.1820e-01 (4.20e-04)	-	7.1958e-01 (2.19e-04)	7.1888e-01 (2.78e-04)	7.1955e-01 (1.80e-04)	7.1946e-01 (2.57e-04)	7.1911e-01 (1.94e-04)	7.1845e-01 (3.24e-04)	7.1936e-01 (1.88e-04)	7.1913e-01 (2.59e-04)	7.1885e-01 (2.86e-04) -
B17-P4-T1	6.7754e-01 (1.59e-01)	-	7.2685e-01 (2.91e-01)	7.1949e-01 (4.97e-04)	7.3285e-01 (1.60e-01)	6.9660e-01 (1.15e-01)	7.1903e-01 (1.05e-03)	7.1885e-01 (8.52e-04)	7.1947e-01 (4.97e-04)	7.1929e-01 (7.10e-04)	5.8467e-01 (2.52e-01) =
B17-P4-T2	0 (0) -	-	7.1599e-01 (1.83e-01)	3.6470e-01 (3.41e-01)	1.7990e-02 (4.31e-02)	0 (0) -	3.5478e-02 (1.36e-02)	3.1440e-01 (1.67e-02)	2.9494e-01 (2.70e-02)	3.1231e-01 (1.52e-02)	2.6922e-01 (2.64e-02) -
B17-P5-T1	2.9795e-01 (2.21e-01)	-	3.0764e-01 (2.07e-02)	2.0672e-01 (2.09e-02)	2.9752e-01 (2.85e-02)	3.1400e-01 (1.67e-02)	3.1440e-01 (1.80e-02)	2.9494e-01 (2.70e-02)	3.0404e-01 (1.97e-03)	3.4214e-01 (9.46e-03) =	3.4271e-01 (8.17e-03) =
B17-P5-T2	2.4063e-02 (4.06e-02) =	1.6135e-02 (3.02e-03)	1.5077e-02 (3.43e-02)	1.6016e-02 (3.38e-02)	2.1005e-02 (3.87e-02)	1.5020e-02 (3.42e-02)	1.8074e-02 (3.68e-02)	1.7976e-01 (1.65e-01)	2.2695e-01 (3.21e-01)	8.8793e-03 (2.71e-02) =	0 (0) -
B17-P6-T1	3.4326e-01 (7.46e-03)	3.3933e-01 (1.09e-02)	3.4295e-01 (7.09e-03)	3.4191e-01 (8.30e-03)	3.3647e-01 (1.10e-02)	3.3867e-01 (1.13e-02)	3.3769e-01 (1.50e-02)	3.4179e-01 (8.12e-03)	3.4004e-01 (9.78e-03)	3.4214e-01 (9.46e-03) =	3.4271e-01 (8.17e-03) =
B17-P6-T2	7.1976e-01 (8.71e-02)	-	0 (0) -	3.3935e-01 (7.15e-03) =	0 (0) -	8.2464e-02 (1.38e-01)	3.3737e-01 (9.91e-03)	1.7973e-01 (1.65e-01)	3.2793e-01 (6.16e-02) =	0 (0) -	1.2036e-02 (3.12e-02) -
B17-P7-T1	3.0874e-02 (5.69e-02)	-	1.0169e-01 (1.15e-02)	9.9522e-01 (9.70e-03)	1.0911e-01 (2.82e-02)	1.0020e-01 (1.10e-02)	1.0145e-01 (9.69e-03)	6.8220e-02 (1.25e-01)	1.0238e-01 (1.08e-02)	4.0405e-02 (7.22e-02) -	1.0419e-01 (1.85e-03) =
B17-P7-T2	7.1976e-01 (2.31e-04)	-	7.1955e-01 (1.56e-04)	7.1949e-01 (1.67e-04)	7.1993e-01 (1.74e-04)	7.1995e-01 (1.69e-04)	7.1984e-01 (2.34e-04)	7.1976e-01 (2.15e-04)	7.1991e-01 (1.26e-04)	7.1993e-01 (1.43e-04) =	2.5395e-02 (7.54e-02) =
B17-P8-T1	9.9979e-01 (3.47e-04)	-	9.9980e-01 (3.50e-04)	9.9981e-01 (2.50e-04)	9.9976e-01 (5.03e-04)	9.9984e-01 (2.57e-04)	9.9985e-01 (2.80e-04)	9.9978e-01 (3.34e-04)	9.9992e-01 (1.48e-04)	9.9985e-01 (2.54e-04)	9.9981e-01 (2.72e-04) =
B17-P8-T2	4.4289e-01 (2.29e-03)	-	4.1680e-01 (6.73e-02)	4.4281e-01 (1.76e-03)	3.9047e-01 (8.71e-02)	4.4305e-01 (2.10e-03)	4.4349e-01 (1.48e-03)	4.3690e-01 (3.53e-02)	4.4353e-01 (1.86e-03) =	4.4366e-01 (1.36e-03)	4.0684e-01 (8.36e-02) =
B17-P9-T1	8.6763e-01 (8.84e-02)	-	9.0471e-01 (8.52e-03)	9.0844e-01 (4.01e-03)	9.0597e-01 (3.27e-03)	8.6364e-01 (1.24e-01)	7.5797e-01 (2.30e-01)	8.3749e-01 (1.89e-01)	8.0987e-01 (2.20e-01)	9.1239e-01 (3.30e-03) +	4.6545e-01 (6.94e-02) =
B17-P9-T2	1.4592e-01 (2.10e-01)	-	0 (0) =	1.3732e-02 (7.52e-02)	0 (0) =	2.9372e-02 (1.12e-01)	1.3849e-02 (7.59e-02)	2.9401e-02 (1.12e-01)	3.7490e-02 (1.17e-01) =	0 (0) =	1.4785e-02 (8.10e-02) =
B18-P1-T1	9.2106e-01 (1.38e-04)	-	9.2110e-01 (7.62e-05)	9.2109e-01 (7.21e-05)	9.2112e-01 (6.26e-05)	9.2111e-01 (7.83e-05)	9.2106e-01 (1.20e-04)	9.2111e-01 (6.57e-05)	9.2107e-01 (1.62e-04)	9.2106e-01 (1.83e-04) =	9.2104e-01 (7.12e-04) =
B18-P1-T2	0.0912e-01 (0.07e-02)	-	0.2279e-01 (1.47e-02)	0.9230e-01 (1.46e-02)	0.2273e-01 (1.47e-02)	0.9390e-01 (1.39e-02)	0.9244e-01 (1.76e-02)	0.9344e-01 (1.04e-01)	0.3663e-01 (1.74e-01)	0.82344e-01 (1.04e-01)	0.8663e-01 (1.74e-01) =
B18-P2-T1	7.5591e-01 (2.40e-04)	-	5.5599e-01 (1.82e-04)	7.5595e-01 (2.14e-04)	7.5597e-01 (1.59e-04)	7.5598e-01 (1.54e-04)	7.5602e-01 (1.90e-04)	7.5601e-01 (1.60e-04)	7.5601e-01 (1.63e-04)	7.5561e-01 (1.60e-04) =	7.5561e-01 (1.61e-04) =
B18-P2-T2	9.3038e-01 (1.26e-04)	-	0.3264e-01 (1.76e-04)	9.3155e-01 (1.19e-04)	0.3265e-01 (5.40e-05)	0.3232e-01 (1.15e-03)	0.3232e-01 (4.55e-04)	0.3005e-01 (1.44e-03)	0.3237e-01 (1.13e-03)	0.3237e-01 (1.16e-03)	0.5776e-01 (5.77e-03) =
B18-P3-T1	5.2293e-01 (9.10e-02)	-	0.2048e-01 (5.27e-02)	6.1450e-01 (5.41e-02)	5.9502e-01 (7.38e-02)	6.2230e-01 (5.56e-02)	6.1882e-01 (5.32e-02)	5.3739e-01 (8.98e-02)	6.3323e-01 (3.02e-02)	6.1434e-01 (8.02e-02)	5.6736e-01 (9.11e-02) =
B18-P3-T2	7.1904e-01 (1.51e-02)	-	0.3026e-01 (1.70e-02)	7.1886e-01 (1.29e-02)	7.2745e-01 (1.21e-02)	7.2470e-01 (1.68e-02)	7.2997e-01 (1.70e-02)	7.2804e-01 (1.17e-02)	7.2679e-01 (8.60e-03)	6.8421e-01 (6.52e-02)	7.2998e-01 (1.06e-02) =
B18-P4-T1	2.3100e-01 (1.91e-02)	-	0.4839e-01 (1.66e-03)	2.4879e-01 (1.40e-02)	2.4718e-01 (1.21e-02)	2.4872e-01 (0.75e-03)	2.5296e-01 (1.04e-02)	2.5678e-01 (1.01e-02)	2.5678e-01 (1.52e-02)	2.5551e-01 (6.83e-03)	2.1280e-01 (1.35e-02) =
B18-P4-T2	1.9609e-01 (1.98e-02)	-	0.2148e-01 (0.28e-02)	0.2088e-01 (1.97e-02)	0.2085e-01 (1.77e-02)	0.21366e-01 (1.91e-02)	0.2161e-01 (2.50e-02)	2.1587e-01 (2.02e-02)	0.2020e-01 (1.51e-02)	1.9117e-01 (3.38e-02)	1.7578e-01 (1.31e-02) =
B18-P5-T1	7.2504e-01 (2.94e-03)	-	7.2504e-01 (2.64e-03)	7.2381e-01 (3.66e-03)	7.2155e-01 (3.24e-03)	7.2576e-01 (5.16e-03)	7.2583e-01 (4.92e-03)	7.2626e-01 (3.14e-03)	7.2652e-01 (2.61e-03)	7.2720e-01 (2.98e-03)	7.1401e-01 (5.24e-03) =
B18-P5-T2	9.9918e-01 (2.52e-04)	-	0.9927e-01 (0.44e-04)	0.9933e-01 (1.77e-04)	0.9924e-01 (3.55e-04)	0.9925e-01 (2.46e-04)	0.9925e-01 (1.99e-04)	0.9922e-01 (3.44e-04)	0.9911e-01 (4.14e-04)	0.9916e-01 (4.86e-04)	0.9916e-01 (5.01e-04) =
B18-P6-T1	6.0391e-01 (0.97e-02)	-	0.5812e-01 (0.91e-02)	6.2328e-01 (0.97e-02)	6.2662e-01 (0.93e-02)	6.4694e-01 (8.50e-02)	6.1745e-01 (8.93e-02)	6.0765e-01 (1.09e-01)	5.9979e-01 (9.51e-02)	6.3740e-01 (8.86e-02)	6.4882e-01 (5.72e-02)
B18-P6-T2	2.6832e-01 (1.20e-02)	-	3.1294e-01 (1.67e-02)	2.8664e-01 (3.54e-02)	2.8151e-01 (3.03e-02)	3.0109e-01 (5.71e-02)	2.7351e-01 (3.12e-02)	3.1283e-01 (7.27e-02)	2.8553e-01 (3.42e-02)	2.5407e-01 (1.25e-02)	1.0566e-01 (6.27e-02)
B18-P7-T1	7.4356e-01 (1.43e-01)	-	5.7529e-01 (8.91e-03)	7.5070e-01 (1.05e-02)	7.5306e-01 (9.25e-03)	7.5164e-01 (8.72e-03)	7.5164e-01 (8.32e-03)	7.5464e-01 (8.32e-03)	7.3115e-01 (2.08e-02)	7.5026e-01 (1.02e-02)	7.5377e-01 (7.57e-03) =
B18-P7-T2	6.3036e-01 (1.10e-01)	-	0.7045e-01 (4.46e-02)	7.0270e-01 (3.97e-03)	7.0270e-01 (3.05e-02)	7.0475e-01 (3.25e-03)	7.0412e-01 (4.01e-03)	6.2857e-01 (1.31e-02)	7.0599e-01 (3.83e-03)	7.0504e-01 (3.87e-03)	5.5652e-01 (1.27e-01) =
B18-P8-T1	6.9079e-01 (2.52e-04)	-	7.1397e-01 (5.82e-03)	7.1504e-01 (5.45e-03)	7.0826e-01 (8.36e-03)	7.0328e-01 (5.18e-03)	7.1455e-01 (6.45e-03)	6.9646e-01 (6.45e-03)	7.1376e-01 (5.37e-03)	5.5892e-01 (1.25e-01) =	3.3079e-01 (1.46e-01) =
B18-P8-T2	7.1432e-01 (5.40e-02)	-	7.1892e-01 (3.14e-03)	7.1752e-01 (3.44e-03)	7.1875e-01 (4.91e-03)	7.1660e-01 (5.90e-03)	7.1394e-01 (7.36e-03)	7.1394e-01 (7.36e-03)	7.1966e-01 (3.81e-03)	7.1824e-01 (3.84e-03)	6.7793e-01 (4.13e-03) =
B18-P9-T1	9.9859e-01 (3.96e-03)	-	9.9860e-01 (2.21e-03)	9.9861e-01 (6.99e-03)	9.9999e-01 (1.73e-03)	9.9981e-01 (6.03e-04)	9.9990e-01 (5.12e-04)	9.9990e-01 (3.79e-04)	1.0000e+00 (9.61e-07)	9.9991e-01 (8.42e-04)	9.9998e-01 (8.64e-05) =
B18-P9-T2	2.1672e-01 (3.56e-02)	-	3.3725e-01 (1.19e-02)	2.1941e-01 (6.86e-02)	3.0690e-01 (6.58e-02)	3.6374e-01 (6.46e-02)	2.1123e-01 (2.32e-02)	2.2113e-01 (9.32e-02)	2.2779e-02 (6.88e-02)	1.4776e-01 (4.83e-02)	1.0799e-01 (3.21e-02) =
B18-P10-T1	8.0893e-03 (3.66e-02)	-	1.4831e-03 (3.99e-03)	7.7259e-03 (7.21e-03)	9.5898e-03 (4.66e-02)	1.0096e-03 (5.33e-03)	4.1205e-03 (1.34e-02)	4.0979e-03 (1.27e-02)	3.3504e-03 (1.25e-02)	1.1498e-03 (5.53e-03)	1.6700e-02 (4.77e-02) =
B18-P10-T2	0 (0) =	-	3.1820e-05 (1.74e-04)	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	1.4681e-02 (6.37e-02) =
B21-P1-T1	2.6096e-02 (4.21e-02)	-	1.7904e-02 (3.96e-02)	2.0704e-02 (4.55e-02)	4.1686e-02 (6.24e-02)	3.3476e-02 (5.60e-02)	2.9716e-02 (6.01e-02)	3.0028e-02 (6.02e-02)	3.0281e-02 (8.41e-02)	2.6564e-02 (4.55e-02) =	0 (0) =
B21-P1-T2	1.2636e-02 (2.88e-02)	-	1.0022e-02 (3.24e-02)	2.5474e-02 (4.55e-02)	4.1686e-02 (6.24e-02)	3.3476e-02 (5.60e-02)	2.9716e-02 (6.01e-02)	3.0028e-02 (6.02e-02)	3.0281e-02 (7.24e-02)	2.6564e-02 (4.55e-02) =	0 (0) =
B21-P2-T1	4.7418e-02 (2.59e-02)	-	2.2876e-02 (5.37e-02)	2.5474e-02 (4.55e-02)	4.1686e-02 (6.24e-02)	3.3476e-02 (5.60e-02)	2.9716e-02 (6.01e-02)	3.0028e-02 (6.02e-02)	3.0281e-02 (8.41e-02)	2.6564e-02 (4.55e-02) =	0 (0) =
B21-P2-T2	0 (0) =	-	1.2318e-03 (8.76e-03)	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =	0 (0) =
B21-P3-T1	9.9042e-03 (7.40e-02)	-	1.9101e-02 (6.76e-02)	<b							

TABLE S-XI
AVERAGE HV VALUES FOR PARAMETER τ ANALYSIS.

	$\tau = 0.01$	$\tau = 0.05$	$\tau = 0.1$	$\tau = 0.2$	$\tau = 0.4$
B21-P1-T1	2.0511e-03 (7.81e-03)	1.3436e-02 (6.46e-02)	2.8127e-03 (1.51e-02)	9.2748e-04 (5.08e-03)	1.7940e-04 (9.83e-04)
B21-P1-T2	0 (0)	3.1036e-03 (1.70e-02)	2.8311e-03 (1.55e-02)	0 (0)	0 (0)
B21-P2-T1	4.0415e-02 (7.85e-02)	4.0656e-02 (6.38e-02)	1.8720e-02 (3.98e-02)	3.5151e-02 (7.63e-02)	1.0532e-02 (1.93e-02)
B21-P2-T2	8.9519e-03 (1.95e-02)	9.5867e-03 (2.45e-02)	2.7241e-02 (7.21e-02)	1.9951e-02 (7.05e-02)	8.9241e-03 (2.65e-02)
B21-P3-T1	6.7841e-03 (2.87e-02)	1.5391e-02 (5.94e-02)	1.8872e-02 (8.16e-02)	1.0868e-02 (4.21e-02)	2.2107e-02 (5.40e-02)
B21-P3-T2	1.2045e-02 (4.76e-02)	0 (0)	0 (0)	0 (0)	5.9166e-03 (3.24e-02)
B21-P4-T1	1.1527e-02 (5.17e-02)	8.6841e-04 (3.51e-03)	1.7375e-03 (6.66e-03)	1.1215e-02 (3.76e-02)	1.6366e-03 (5.90e-03)
B21-P4-T2	1.1717e-03 (4.75e-03)	1.2082e-02 (4.78e-02)	4.9127e-03 (2.69e-02)	6.7042e-03 (3.58e-02)	4.7648e-03 (1.38e-02)
B21-P5-T1	3.7520e-02 (9.51e-02)	3.9161e-02 (9.34e-02)	3.6749e-02 (9.07e-02)	1.4716e-02 (5.47e-02)	1.6734e-02 (6.83e-02)
B21-P5-T2	3.3374e-02 (1.03e-01)	5.4861e-02 (1.05e-01)	4.3569e-02 (9.52e-02)	3.2093e-02 (8.75e-02)	5.9559e-02 (1.43e-01)
B21-P6-T1	2.6943e-02 (7.29e-02)	2.2652e-02 (4.70e-02)	3.7415e-02 (7.86e-02)	2.0997e-02 (4.89e-02)	1.8360e-02 (4.10e-02)
B21-P6-T2	1.6005e-02 (3.53e-02)	1.9628e-03 (8.47e-03)	2.3161e-02 (8.90e-02)	1.3334e-02 (5.85e-02)	1.7147e-02 (5.06e-02)
B21-P7-T1	2.2983e-03 (1.26e-02)	1.1575e-02 (3.43e-02)	0 (0)	0 (0)	0 (0)
B21-P7-T2	6.0321e-03 (3.30e-02)	0 (0)	9.9385e-03 (3.93e-02)	1.9581e-03 (1.07e-02)	7.0169e-03 (2.43e-02)
B21-P8-T1	1.3330e-03 (4.55e-03)	2.1689e-03 (5.93e-03)	6.4790e-03 (1.55e-02)	3.0053e-03 (1.04e-02)	2.1719e-02 (6.64e-02)
B21-P8-T2	3.0303e-03 (1.66e-02)	0 (0)	1.0812e-03 (5.92e-03)	0 (0)	1.7193e-03 (7.62e-03)
B21-P9-T1	1.5776e-03 (8.64e-03)	1.0851e-04 (3.33e-04)	1.0197e-03 (4.39e-03)	4.9041e-04 (2.69e-03)	1.1578e-02 (6.34e-02)
B21-P9-T2	0 (0)	0 (0)	0 (0)	4.2669e-03 (1.77e-02)	0 (0)
B21-P10-T1	2.5581e-02 (6.18e-02)	2.2203e-02 (7.08e-02)	6.5175e-03 (3.27e-02)	0 (0)	2.5070e-02 (7.49e-02)
B21-P10-T2	0 (0)	9.3200e-04 (5.10e-03)	0 (0)	5.0353e-03 (2.76e-02)	0 (0)
Ranking (p)	2.875 (0.689)	2.900 (0.652)	2.675	3.475 (0.109)	3.075 (0.423)

TABLE S-XII
AVERAGE IGD+ VALUES FOR PARAMETER α_0^C ANALYSIS.

	$\alpha_0^C = 0.1$	$\alpha_0^C = 0.2$	$\alpha_0^C = 0.3$	$\alpha_0^C = 0.4$	$\alpha_0^C = 0.5$
B21-P1-T1	2.1709e+04 (1.51e+04)	2.1075e+04 (1.23e+04)	2.2862e+04 (1.37e+04)	3.0695e+04 (2.62e+04)	2.2372e+04 (1.42e+04)
B21-P1-T2	2.4242e+04 (1.33e+04)	2.5307e+04 (1.80e+04)	1.9286e+04 (9.32e+03)	2.0923e+04 (1.01e+04)	2.0281e+04 (1.20e+04)
B21-P2-T1	2.2341e+01 (1.15e+01)	2.1657e+01 (5.14e+00)	2.1117e+01 (5.28e+00)	2.3752e+01 (1.13e+01)	2.7618e+01 (1.89e+01)
B21-P2-T2	2.1771e+01 (5.08e+00)	2.1988e+01 (4.84e+00)	2.0422e+01 (4.52e+00)	2.0904e+01 (5.28e+00)	2.4115e+01 (1.58e+01)
B21-P3-T1	4.1636e+02 (2.50e+02)	3.7932e+02 (2.88e+02)	3.7309e+02 (2.55e+02)	2.8409e+02 (1.73e+02)	3.2443e+02 (2.00e+02)
B21-P3-T2	5.1615e+02 (3.25e+02)	5.9003e+02 (3.36e+02)	4.0038e+02 (3.03e+02)	4.0888e+02 (2.42e+02)	4.2025e+02 (2.98e+02)
B21-P4-T1	2.1447e+01 (6.35e+00)	1.9521e+01 (7.64e+00)	2.3459e+01 (8.65e+00)	2.1981e+01 (8.55e+00)	2.3035e+01 (5.25e+00)
B21-P4-T2	2.9021e+01 (1.09e+01)	2.5038e+01 (6.87e+00)	2.6756e+01 (1.04e+01)	2.7576e+01 (8.75e+00)	2.7641e+01 (7.00e+00)
B21-P5-T1	7.1494e+01 (5.53e+01)	8.6465e+01 (4.19e+01)	6.5818e+01 (5.94e+01)	7.6472e+01 (5.36e+01)	7.4687e+01 (5.85e+01)
B21-P5-T2	2.4534e+01 (3.23e+01)	3.0311e+01 (3.73e+01)	3.6025e+01 (4.20e+01)	3.3555e+01 (3.80e+01)	1.8402e+01 (2.92e+01)
B21-P6-T1	8.4725e+01 (2.18e+01)	8.5353e+01 (1.48e+01)	8.2767e+01 (1.55e+01)	8.3132e+01 (1.46e+01)	8.6552e+01 (1.23e+01)
B21-P6-T2	8.8304e+01 (1.35e+01)	9.2552e+01 (1.62e+01)	9.6001e+01 (2.19e+01)	9.2723e+01 (1.84e+01)	9.1869e+01 (1.46e+01)
B21-P7-T1	2.5886e+01 (8.87e+00)	2.8278e+01 (1.02e+01)	2.7683e+01 (1.16e+01)	2.4443e+01 (7.48e+00)	2.8268e+01 (9.19e+00)
B21-P7-T2	4.0136e+01 (1.19e+01)	4.2004e+01 (1.47e+01)	4.6899e+01 (1.33e+01)	4.5497e+01 (1.28e+01)	4.4822e+01 (1.02e+01)
B21-P8-T1	1.5640e+03 (1.80e+03)	1.8456e+03 (2.03e+03)	1.5486e+03 (1.38e+03)	1.9506e+03 (2.23e+03)	9.5740e+02 (8.16e+02)
B21-P8-T2	5.6770e+02 (1.67e+02)	6.2279e+02 (5.30e+02)	7.7976e+02 (5.30e+02)	5.8489e+02 (1.83e+02)	6.7751e+02 (3.19e+02)
B21-P9-T1	6.1373e+03 (7.64e+02)	6.0987e+03 (8.91e+02)	6.2055e+03 (8.36e+02)	6.2676e+03 (1.03e+03)	6.0076e+03 (1.07e+03)
B21-P9-T2	5.6821e+02 (3.22e+02)	7.2829e+02 (8.84e+02)	6.2028e+02 (6.76e+02)	5.5506e+02 (3.42e+02)	7.4262e+02 (7.30e+02)
B21-P10-T1	2.2934e+01 (6.34e+00)	2.5167e+01 (9.10e+00)	2.8600e+01 (7.49e+00)	2.3254e+01 (5.92e+00)	2.4369e+01 (6.50e+00)
B21-P10-T2	9.9238e+04 (4.92e+04)	8.7731e+04 (3.68e+04)	9.5927e+04 (5.19e+04)	1.0060e+05 (6.12e+04)	1.0387e+05 (5.77e+04)
Ranking (p)	2.600	3.150 (0.271)	2.950 (0.483)	3.050 (0.368)	3.250 (0.193)

TABLE S-XIII
AVERAGE HV VALUES FOR THE INITIAL VALUE OF PARAMETER α_0^C ANALYSIS.

	$\alpha_0^C = 0.1$	$\alpha_0^C = 0.2$	$\alpha_0^C = 0.3$	$\alpha_0^C = 0.4$	$\alpha_0^C = 0.5$
B21-P1-T1	8.1435e-03 (2.69e-02)	1.5935e-03 (6.78e-03)	9.8558e-03 (3.90e-02)	4.5583e-03 (2.50e-02)	3.0849e-02 (1.07e-01)
B21-P1-T2	3.0534e-03 (1.67e-02)	2.2328e-03 (1.22e-02)	0 (0)	0 (0)	0 (0)
B21-P2-T1	3.4287e-02 (5.84e-02)	3.2583e-02 (6.13e-02)	5.1677e-02 (9.80e-02)	2.8450e-02 (5.86e-02)	3.8569e-02 (7.56e-02)
B21-P2-T2	1.1044e-02 (2.86e-02)	9.3142e-03 (3.12e-02)	1.8003e-02 (5.42e-02)	2.9337e-02 (9.55e-02)	3.2340e-02 (5.80e-02)
B21-P3-T1	8.9245e-03 (4.89e-02)	2.5378e-02 (7.15e-02)	9.1872e-03 (3.96e-02)	1.2119e-02 (5.78e-02)	1.1669e-02 (6.35e-02)
B21-P3-T2	1.0405e-02 (4.23e-02)	0 (0)	9.2093e-04 (5.04e-03)	8.9138e-05 (4.88e-04)	1.2584e-03 (6.89e-03)
B21-P4-T1	9.0826e-03 (4.97e-02)	1.1552e-02 (3.51e-02)	4.6519e-03 (1.58e-02)	8.5845e-04 (4.28e-03)	0 (0)
B21-P4-T2	0 (0)	3.8333e-03 (2.03e-02)	1.4889e-04 (8.15e-04)	9.0905e-03 (4.98e-02)	2.8837e-03 (1.58e-02)
B21-P5-T1	4.0264e-02 (1.04e-01)	9.8233e-03 (4.64e-02)	7.1707e-02 (1.25e-01)	2.5269e-02 (7.96e-02)	3.7558e-02 (9.17e-02)
B21-P5-T2	1.0258e-02 (4.41e-02)	3.4121e-02 (9.61e-02)	4.3057e-02 (1.18e-01)	3.5422e-02 (8.65e-02)	2.3022e-02 (8.28e-02)
B21-P6-T1	4.6265e-02 (8.99e-02)	2.6738e-02 (7.76e-02)	4.0479e-02 (7.57e-02)	2.8637e-02 (6.65e-02)	1.2502e-02 (2.88e-02)
B21-P6-T2	8.6012e-04 (2.14e-03)	3.1359e-02 (5.61e-02)	1.3158e-02 (6.34e-02)	5.3177e-03 (2.13e-02)	2.0302e-03 (9.98e-03)
B21-P7-T1	3.0947e-02 (9.59e-02)	1.8534e-02 (5.44e-02)	7.1896e-03 (2.64e-02)	2.6298e-02 (7.23e-02)	1.4329e-03 (7.43e-03)
B21-P7-T2	0 (0)	1.4070e-02 (5.37e-02)	0 (0)	0 (0)	0 (0)
B21-P8-T1	2.6739e-02 (6.32e-02)	1.9720e-02 (6.64e-02)	3.0240e-02 (6.82e-02)	1.0073e-02 (3.09e-02)	2.6726e-02 (6.20e-02)
B21-P8-T2	3.1469e-03 (1.72e-02)	0 (0)	0 (0)	0 (0)	0 (0)
B21-P9-T1	3.3329e-02 (5.14e-02)	4.7508e-02 (8.04e-02)	3.8099e-02 (7.23e-02)	4.6042e-02 (7.46e-02)	6.8142e-02 (1.08e-01)
B21-P9-T2	0 (0)	3.0332e-03 (1.66e-02)	6.4909e-04 (3.56e-03)	0 (0)	0 (0)
B21-P10-T1	9.2251e-02 (1.66e-01)	9.2372e-02 (1.55e-01)	1.5270e-02 (4.29e-02)	6.5851e-02 (9.37e-02)	5.5314e-02 (9.79e-02)
B21-P10-T2	0 (0)	0 (0)	0 (0)	3.0321e-03 (1.66e-02)	0 (0)
Ranking (p)	2.950 (0.802)	2.850 (0.960)	2.825	3.150 (0.515)	3.225 (0.423)

TABLE S-XIV
AVERAGE HV VALUES FOR COMPARISON ON OPTIMAL POWER FLOW PROBLEMS.

SPEA2	LMOCSO	CMOCOSO	CCMO	MO-MFEA	MO-MFEA-II	EMT-ET	EMT-PD	MTEA-DCK
OPF-P1-T1	1.0306e-01 (1.47e-04) -	0 (0) -	1.0310e-01 (1.50e-04) -	1.0325e-01 (8.23e-05) -	1.0334e-01 (4.80e-05) -	1.0342e-01 (2.03e-04) =	1.0330e-01 (5.41e-05) -	1.0345e-01 (6.76e-05)
OPF-P1-T2	5.2423e-02 (2.23e-03) -	0 (0) -	5.2698e-02 (1.02e-03) -	4.9162e-02 (1.04e-02) -	5.3002e-02 (2.05e-04) -	5.2962e-02 (3.15e-04) -	5.2965e-02 (2.49e-04) -	5.3241e-02 (7.88e-05)
OPF-P2-T1	6.7595e-02 (8.87e-04) -	4.3929e-03 (7.32e-03) -	6.7200e-02 (5.07e-04) -	6.7931e-02 (5.67e-04) -	6.7677e-02 (7.99e-04) -	6.8620e-02 (4.00e-04) -	6.7370e-02 (7.37e-04) -	6.7405e-02 (9.71e-04) -
OPF-P2-T2	1.4443e-02 (1.98e-03) -	0 (0) -	1.6639e-02 (1.25e-03) =	1.3543e-02 (2.87e-03) -	1.7821e-02 (1.39e-03) +	1.8816e-02 (1.39e-03) +	1.7816e-02 (1.27e-03) +	1.7587e-02 (1.57e-03) +
OPF-P3-T1	1.0158e-01 (1.39e-03) -	4.3471e-02 (8.67e-03) -	1.0132e-01 (1.44e-03) -	1.0242e-01 (1.56e-03) -	1.0194e-01 (1.29e-03) -	1.0223e-01 (1.28e-03) -	1.0064e-01 (1.53e-03) -	1.0106e-01 (1.50e-03) -
OPF-P3-T2	3.9137e-02 (4.38e-03) -	9.1341e-03 (1.10e-02) -	4.0097e-02 (2.61e-03) -	3.3631e-02 (6.73e-03) -	4.1057e-02 (2.16e-03) -	4.0488e-02 (4.24e-03) -	4.1524e-02 (2.00e-03) -	4.4776e-02 (1.11e-03)
OPF-P4-T1	6.3851e-02 (1.47e-03) -	2.7531e-02 (5.81e-03) -	6.3958e-02 (1.17e-03) -	6.4200e-02 (1.11e-03) -	6.0089e-02 (2.33e-03) -	6.3860e-02 (1.33e-03) -	6.0956e-02 (1.83e-03) -	6.1653e-02 (2.33e-03) -
OPF-P4-T2	2.7564e-02 (3.15e-03) -	3.5298e-03 (6.15e-03) -	3.0141e-02 (1.28e-03) -	2.7743e-02 (3.62e-03) -	3.2666e-02 (1.58e-03) =	3.3216e-02 (2.16e-03) =	3.1526e-02 (2.51e-03) -	3.2156e-02 (1.84e-03) -
+/-=	0/8/0	0/8/0	0/7/1	0/8/0	1/6/1	1/5/2	1/7/0	
Ranking (p)	6.500 (0.000)	9.000 (0.000)	6.000 (0.001)	5.500 (0.004)	3.625 (0.144)	2.625 (0.465)	4.937 (0.015)	5.187 (0.009)
								Base

TABLE S-XV
AVERAGE HV VALUES FOR COMPARISON ON SYNCHRONOUS OPTIMAL PULSE-WIDTH MODULATION PROBLEMS.

SPEA2	LMOCSO	CMOCOSO	CCMO	MO-MFEA	MO-MFEA-II	EMT-ET	EMT-PD	MTEA-DCK
SOPM-P1-T1	2.3306e-01 (1.95e-01) =	0 (0) -	6.0617e-02 (8.93e-02) -	1.0179e-01 (1.42e-01) -	2.5149e-01 (1.88e-01) =	1.7911e-01 (1.44e-01) =	1.7987e-02 (9.85e-02) -	2.3249e-01 (1.97e-01) =
SOPM-P1-T2	1.2595e-01 (2.16e-01) -	0 (0) -	4.5025e-02 (1.25e-01) -	5.2553e-02 (1.11e-01) -	2.9464e-01 (2.91e-01) -	1.5423e-01 (2.37e-01) -	1.7840e-02 (9.77e-02) -	5.8679e-01 (5.56e-02)
SOPM-P1-T3	4.4711e-01 (3.34e-01) =	0 (0) -	9.6634e-02 (2.26e-01) -	1.4414e-01 (2.71e-01) -	4.9415e-01 (3.40e-01) =	5.3189e-01 (3.11e-01) =	2.7035e-02 (1.25e-01) -	4.2468e-01 (3.48e-01) =
SOPM-P2-T1	1.1833e-01 (2.32e-01) -	0 (0) -	8.3003e-02 (1.67e-01) -	1.4001e-01 (2.37e-01) -	1.9949e-01 (2.72e-01) -	2.5932e-01 (2.90e-01) =	0 (0) -	2.3542e-01 (2.88e-01) -
SOPM-P2-T2	4.9835e-02 (1.59e-01) -	0 (0) -	4.5394e-02 (1.20e-01) -	3.2070e-02 (9.29e-02) -	1.4028e-01 (2.38e-01) -	1.3339e-01 (2.02e-01) -	0 (0) -	1.5213e-01 (2.19e-01) -
SOPM-P2-T3	1.6535e-01 (2.27e-01) -	0 (0) -	2.5403e-02 (8.53e-02) -	5.5510e-02 (1.49e-01) -	1.5886e-01 (2.23e-01) -	2.0825e-01 (2.31e-01) -	0 (0) -	1.8093e-01 (2.18e-01) -
+/-=	0/4/2	0/6/0	0/6/0	0/6/0	0/4/2	0/3/3	0/6/0	0/4/2
Ranking (p)	4.333 (0.073)	8.750 (0.000)	6.833 (0.000)	6.000 (0.004)	3.000 (0.342)	3.166 (0.291)	8.250 (0.000)	3.166 (0.291)
								Base

TABLE S-XVI
AVERAGE HV VALUES FOR COMPARISON ON SENSOR COVERAGE PROBLEMS.

SPEA2	NSGA-III	MOEA/D-DE	LMOCSO	MO-MFEA	EMT-PD	MO-SBO	MO-MaTDE	MTEA-DCK
MOSCP-5T-T1	2.2172e-01 (6.67e-03) -	2.1673e-01 (7.65e-03) -	1.9058e-01 (8.47e-03) -	1.8884e-01 (6.80e-03) -	2.3967e-01 (3.37e-03) -	2.4179e-01 (7.37e-03) =	2.2397e-01 (5.53e-03) -	2.0789e-01 (6.80e-03) -
MOSCP-5T-T2	2.2689e-01 (5.80e-03) -	2.2272e-01 (6.10e-03) -	1.9467e-01 (8.09e-03) -	1.9521e-01 (8.71e-03) -	2.4730e-01 (3.11e-03) -	2.5077e-01 (5.90e-03) =	2.2957e-01 (6.32e-03) -	2.1394e-01 (7.32e-03) -
MOSCP-5T-T3	2.3465e-01 (6.15e-03) -	2.2491e-01 (6.61e-03) -	2.0017e-01 (7.31e-03) -	2.0205e-01 (6.88e-03) -	2.5423e-01 (2.81e-03) -	2.5645e-01 (6.88e-03) =	2.3437e-01 (6.70e-03) -	2.1876e-01 (6.34e-03) -
MOSCP-5T-T4	2.3277e-01 (6.32e-03) -	2.2924e-01 (7.83e-03) -	1.9924e-01 (8.25e-03) -	1.9971e-01 (8.77e-03) -	2.5459e-01 (2.69e-03) -	2.5597e-01 (6.87e-03) =	2.3601e-01 (5.09e-03) -	2.1658e-01 (6.92e-03) -
MOSCP-5T-T5	2.3242e-01 (7.02e-03) -	2.2439e-01 (6.38e-03) -	1.9821e-01 (8.13e-03) -	2.0308e-01 (9.65e-03) -	2.5145e-01 (2.52e-03) -	2.5249e-01 (5.32e-03) =	2.3402e-01 (5.84e-03) -	2.1581e-01 (6.35e-03) -
MOSCP-10T-T1	2.0806e-01 (7.26e-03) -	2.0420e-01 (6.31e-03) -	1.7760e-01 (8.46e-03) -	1.7441e-01 (8.12e-03) -	2.2401e-01 (2.92e-03) -	2.2469e-01 (6.20e-03) -	2.1007e-01 (4.48e-03) -	1.9455e-01 (8.31e-03) -
MOSCP-10T-T2	2.0663e-01 (5.48e-03) -	2.0242e-01 (7.00e-03) -	1.7933e-01 (6.21e-03) -	1.7663e-01 (8.79e-03) -	2.2561e-01 (2.65e-03) -	2.2568e-01 (6.17e-03) -	2.0790e-01 (4.28e-03) -	1.9252e-01 (6.13e-03) -
MOSCP-10T-T3	2.1190e-01 (5.42e-03) -	2.0856e-01 (5.90e-03) -	1.8126e-01 (8.80e-03) -	1.8477e-01 (7.37e-03) -	2.3207e-01 (2.62e-03) -	2.3266e-01 (5.65e-03) -	2.1281e-01 (4.99e-03) -	1.9797e-01 (8.12e-03) -
MOSCP-10T-T4	2.1673e-01 (7.17e-03) -	2.1484e-01 (7.78e-03) -	1.8817e-01 (8.22e-03) -	1.8559e-01 (7.94e-03) -	2.3844e-01 (2.10e-03) -	2.3853e-01 (4.73e-03) -	2.1981e-01 (5.01e-03) -	2.0439e-01 (7.12e-03) -
MOSCP-10T-T5	2.2173e-01 (6.20e-03) -	2.1786e-01 (7.95e-03) -	1.9018e-01 (7.61e-03) -	1.9232e-01 (6.59e-03) -	2.4327e-01 (2.43e-03) =	2.4247e-01 (5.67e-03) =	2.2461e-01 (5.80e-03) -	2.0722e-01 (6.57e-03) -
MOSCP-10T-T6	2.1827e-01 (7.30e-03) -	2.1557e-01 (6.70e-03) -	1.8833e-01 (5.92e-03) -	1.9148e-01 (7.94e-03) -	2.4087e-01 (2.20e-03) -	2.3917e-01 (4.70e-03) -	2.2261e-01 (4.65e-03) -	2.0570e-01 (5.91e-03) -
MOSCP-10T-T7	2.2587e-01 (5.06e-03) -	2.2049e-01 (7.81e-03) -	1.9582e-01 (6.70e-03) -	1.9808e-01 (7.85e-03) -	2.4752e-01 (2.28e-03) -	2.4586e-01 (4.61e-03) -	2.2891e-01 (5.57e-03) -	2.0935e-01 (5.67e-03) -
MOSCP-10T-T8	2.2439e-01 (6.47e-03) -	2.1955e-01 (5.12e-03) -	1.9286e-01 (7.71e-03) -	1.9771e-01 (9.06e-03) -	2.4643e-01 (1.90e-03) -	2.4393e-01 (4.48e-03) -	2.2919e-01 (4.41e-03) -	2.0890e-01 (6.28e-03) -
MOSCP-10T-T9	2.1226e-01 (6.06e-03) -	2.0424e-01 (6.97e-03) -	1.7975e-01 (5.60e-03) -	1.8549e-01 (6.74e-03) -	2.2810e-01 (1.52e-03) -	2.2646e-01 (3.16e-03) -	2.1340e-01 (4.45e-03) -	1.9523e-01 (5.91e-03) -
MOSCP-10T-T10	2.1001e-01 (4.77e-03) -	2.0521e-01 (4.99e-03) -	1.7991e-01 (5.50e-03) -	1.8441e-01 (6.94e-03) -	2.2533e-01 (1.45e-03) -	2.2344e-01 (3.27e-03) -	2.1101e-01 (3.93e-03) -	1.9576e-01 (6.65e-03) -
+/-=	0/15/0	0/15/0	0/15/0	0/15/0	0/13/2	0/9/6	0/15/0	
Ranking (p)	4.930 (0.000)	6.000 (0.000)	8.733 (0.000)	8.266 (0.000)	2.600 (0.109)	2.400 (0.161)	4.066 (0.002)	7.000 (0.000)
								Base

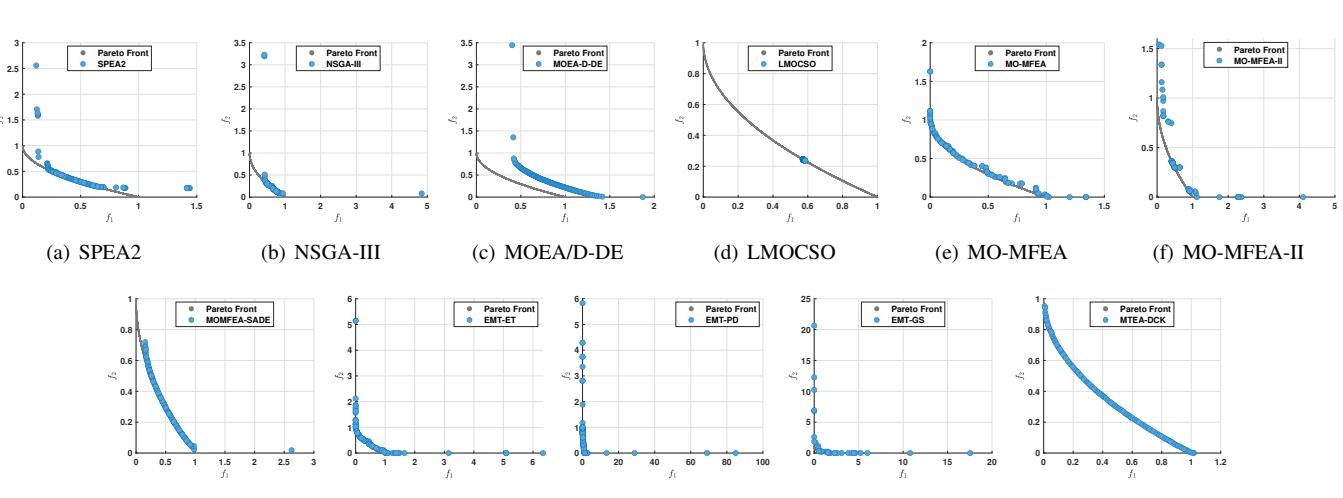


Fig. S-4. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B19-P2-T2.

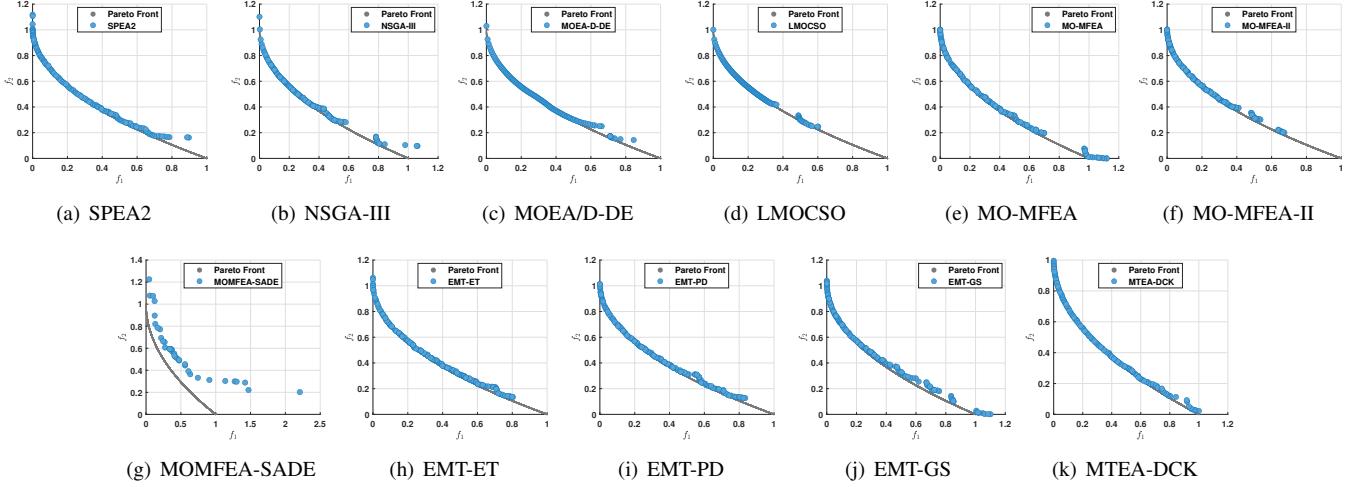


Fig. S-5. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B19-P5-T1.

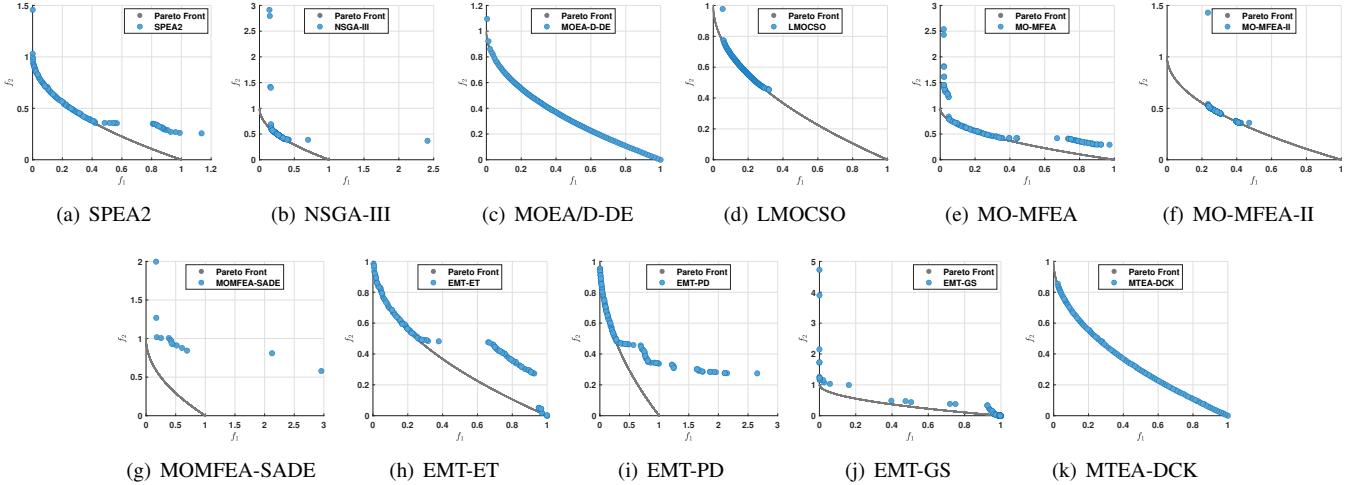


Fig. S-6. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B19-P10-T1.

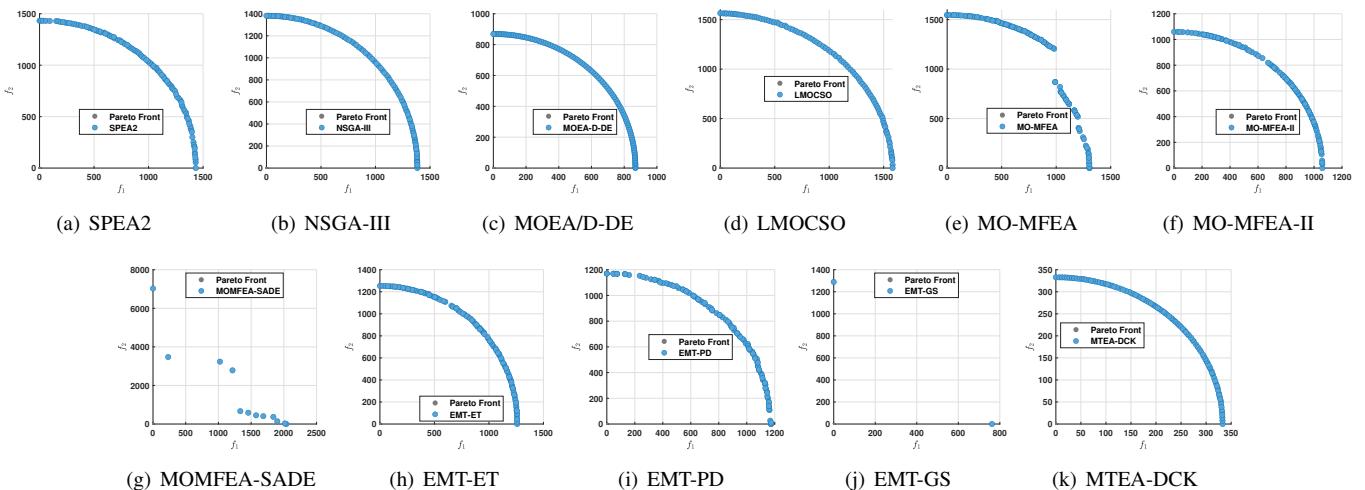


Fig. S-7. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B21-P3-T1.

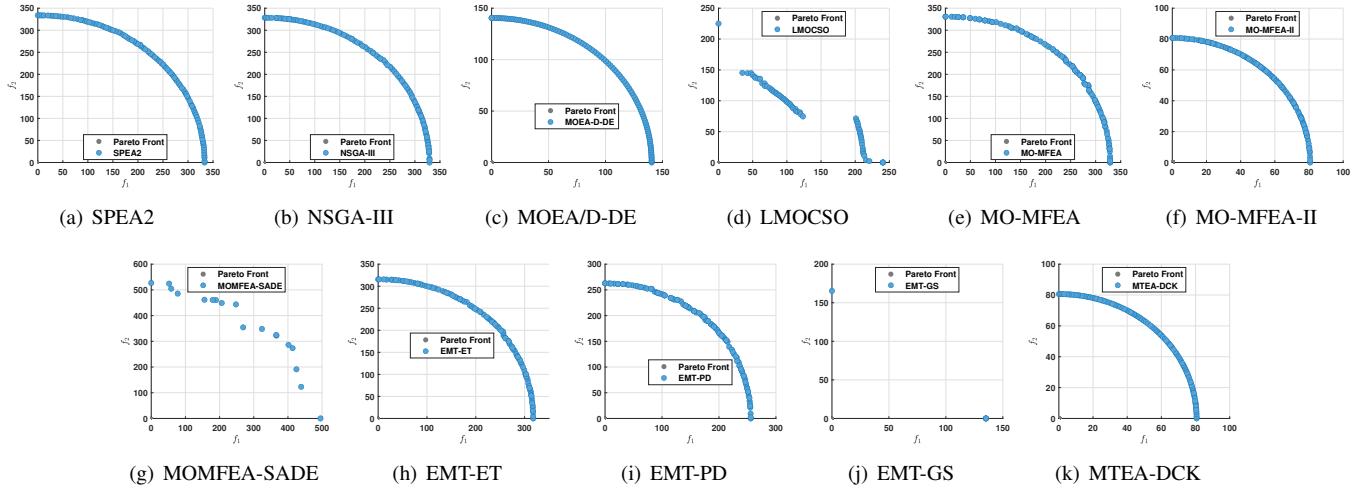


Fig. S-8. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B21-P6-T1.

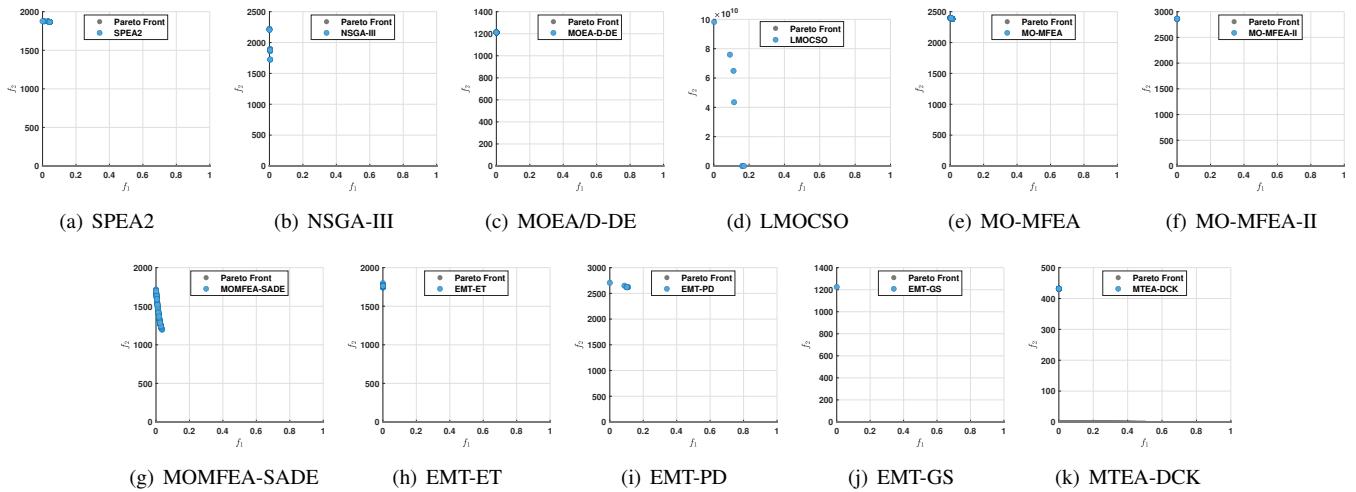


Fig. S-9. Final non-dominated solutions (the median result of 30 runs) of each algorithm on B21-P9-T2.