

Supplementary File for “Coevolutionary Multitasking for Constrained Multiobjective Optimization”

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I. REPRESENTATIVE ALGORITHMS FOR DIFFERENT CONSTRAINT-HANDLING TECHNIQUES

Most CMOEAs primarily focus on designing effective CHTs for solving CMOPs. These CHTs fall into four common categories: CVP-based, CDP-based, COT-based, and CMT-based CHTs, each of which is detailed below.

CVP-based CHTs incorporate the $CV(x)$ into the objective function as a penalty term. This transformation aims to convert CMOPs into equivalent unconstrained MOPs. The critical aspect of this approach lies in determining the appropriate penalty coefficient, which significantly influences the algorithm's efficiency. Selecting the appropriate penalty coefficient is of paramount importance. If it's too small, it may fail to exert enough constraint pressure, causing the population to drift into the infeasible region. On the other hand, if the penalty coefficient is too large, it might trap the population in the local feasible region, preventing it from reaching the global optimum. In the c-DPEA [1], infeasible solutions are adjusted using a penalty function. Promising infeasible solutions are retained in the next generation alongside feasible ones after this adjustment. The penalty coefficient is based on the normalized $CV(x)$ of the infeasible solution. ShiP [2] proposes a shift-based penalty mechanism. In this approach, each infeasible solution is paired with two nearby feasible solutions to establish a local feasible nadir, guiding the direction of the penalty for the infeasible solution. The penalty coefficient is set as a constant multiple of the proportion of feasible solutions within the current parent and offspring populations. In CRSDE [3], individual fitness is computed using a penalty function, which is a combination of a fitness evaluator $E(x)$ and a penalty factor $P(x)$. This penalty factor takes into account both constraint violation and objective function penalties. The penalty coefficient is derived from the ratio of feasible solutions in the current population. In TPDE [4], evolution is split into two phases: exploration and development, both utilizing the $CV(x)$ as a penalty term. During exploration, the population is divided into multiple subpopulations, each assigned a unique penalty coefficient. In the development phase, the penalty coefficient depends on the ratio of feasible solutions and the number of generations.

CDP-based CHTs commonly prioritize solution feasibility during performance evaluation, and they are widely adopted because of their straightforward implementation, as in NSGAII [5]. The specific criteria used for comparison in CDP are as follows:

$$x \prec_{CDP} y, \text{if } \begin{cases} CV(x) < CV(y) \\ CV(x) = CV(y) \& x \prec y \end{cases} \quad (1)$$

where $x \prec_{CDP} y$ signifies that, according to CDP criteria, the performance of x surpasses that of y . According to (4), feasible solutions have a definite advantage over infeasible ones. Additionally, when evaluating two infeasible solutions, the solution with a lower level of constraint violation is considered superior to the one with a higher constraint violation.

As a consequence, CDP prioritizes individuals based on their adherence to constraints, potentially leading to populations becoming concentrated in specific, locally feasible regions. To mitigate this drawback, the ε -level CDP is developed in [6], in which a parameter called ε is defined to relax the constraint conditions. When the $CV(x)$ of a solution x is less than ε , it is considered feasible, even if it's not precisely equal to 0. When ε is gradually reduced to 0, the ε -level CDP converges to the standard CDP. Hence, the tuning of ε holds paramount significance. If the initial value of ε is excessively large, it could lead to an extensive feasible region, potentially confining the population to local areas. Conversely, a rapid reduction in ε might abruptly render solutions near the feasible region as infeasible, resulting in the loss of potentially valuable solutions. In CRSDE [3], an ε -level CDP approach is employed to partition the population into three distinct subsets: the feasible subpopulation, semi-feasible subpopulation, and infeasible subpopulation. In [7], a thorough examination of five commonly utilized ε adjustment methods is conducted, analyzing their pros and cons, and developing an adaptive ε adjustment strategy. MFO [8] uses the exponential function of the simulated annealing algorithm to regulate the variation of ε . Additionally, MTCMO [9] design an exponential function to control the ε variation by incorporating the initial ε value and the number of generations.

COT-based CHTs address constraints by treating them as supplementary objectives, transforming CMOPs into MOPs. This allows existing MOEAs to be used for problem solving. However, since the exact number of constraints is often uncertain, converting each constraint into an objective may lead to a many-objective optimization problem, increasing the problem's complexity. Therefore, the more common practice is to adopt the minimization of $CV(x)$ as an optimization objective. In ToR [10], the m objectives are combined into a single optimization objective through a weighted sum, thereby creating a two-objective optimization problem in conjunction with the $CV(x)$. NRC [11] extends this concept by including $CV(x)$ as an additional objective, which results in an optimization problem with $(m + 1)$ objectives. In CMOEA-MS [12], when the population contains a limited number of feasible solutions, the optimization problem is simplified to a two-objective scenario, involving the minimization of shift density estimation-based distance and $CV(x)$.

CMT-based CHTs partition the optimization process into distinct stages, each aimed at achieving specific goals. One of the most classical representatives is the push-pull search (PPS) framework [13]. During the “push” phase, no constraints are taken into account, and the goal is to propel the population toward the UPF. In contrast, the “pull” phase considers all constraints, with the aim of guiding the population back to the CPF. Notable advancements in PPS algorithms encompass CMOES [14], URCMO [15], and MSCMO [16]. Specifically, CMOES categorizes the population into three groups during the pull phase based on the feasible non-dominated set (FNDS). Solutions dominated by FNDS and those not dominated by FNDS are adjusted toward FNDS to enhance convergence. URCMO evaluates the relationship between CPFs and UPFs after the push phase. In the pull phase, different genetic

operators are selected based on this relationship. MSCMO divides the evolutionary process into stages determined by the number of constraints. New constraints are introduced at the beginning of each stage, gradually transitioning from considering a subset of constraints to addressing all of them. At the end of each stage, the best solutions are archived, and a new population is initialized for the next stage.

A. Results on Real-World CMOPs

In this section, we assess ACEMT's performance in solving real-world CMOPs. We use ACEMT alongside its competitors to solve the RWMOP test suite [17], which is derived from practical CMOPs. Due to the true CPF for these CMOPs is unknown, we rely solely on the HV metric to evaluate the performance of the solvers. Detailed HV results are available in Fig. SXVII. These HV results indicate that ACEMT exhibits a notable edge over its competitors when it comes to solving the RWMOP problems.

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TABLE SI
THE AVERAGE HV RESULTS OBTAINED BY ACEMT AND ITS SEVEN CEMT-BASED COMPETITORS ON THREE TEST BENCHMARK SUITES.

Problem	M	D	BiCo	CMEGL	CMOEMT	MCCMO	MFO-MOEAD	MTCMO	TPEA	ACEMT
CF1	2	10	5.5445e-1 (1.67e-3)	7.7275e-1 (3.32e-4)	5.6035e-1 (6.37e-4)	5.6216e-1 (1.01e-3)	5.6129e-1 (9.97e-4)	5.6110e-1 (5.93e-4)	7.7451e-1 (2.34e-4)	
CF2	2	10	6.2427e-1 (2.83e-2)	8.5488e-1 (1.57e-2)	6.7699e-1 (1.91e-3)	6.4936e-1 (1.69e-2)	5.5058e-1 (3.68e-2)	6.4318e-1 (2.31e-2)	6.5740e-1 (1.12e-2)	8.8854e-1 (2.74e-4)
CF3	2	10	1.9059e-1 (4.08e-2)	3.6782e-1 (4.11e-2)	2.1345e-1 (4.81e-2)	1.9052e-1 (3.65e-2)	1.2205e-1 (5.30e-2)	1.7329e-1 (3.89e-2)	2.0678e-1 (4.28e-2)	4.3815e-1 (5.99e-2)
CF4	2	10	4.2424e-1 (3.63e-2)	6.0153e-1 (3.88e-2)	4.9840e-1 (1.21e-2)	4.3997e-1 (3.17e-2)	3.3147e-1 (7.15e-2)	4.1816e-1 (3.74e-2)	4.5080e-1 (3.40e-2)	7.1393e-1 (8.35e-3)
CF5	2	10	2.8001e-1 (7.84e-2)	4.4680e-1 (6.96e-2)	3.7313e-1 (6.67e-2)	3.0601e-1 (6.99e-2)	2.2809e-1 (5.22e-2)	2.7376e-1 (7.99e-2)	2.8419e-1 (6.17e-2)	6.0508e-1 (3.82e-2)
CF6	2	10	6.4244e-1 (1.65e-2)	8.5649e-1 (1.91e-2)	6.7678e-1 (8.27e-3)	6.5996e-1 (1.25e-2)	5.6625e-1 (5.01e-2)	6.5716e-1 (1.08e-2)	6.6574e-1 (9.42e-3)	9.0008e-1 (2.88e-3)
CF7	2	10	4.8071e-1 (6.90e-2)	6.1121e-1 (9.62e-2)	4.7598e-1 (6.89e-2)	4.7895e-1 (7.14e-2)	3.6785e-1 (9.81e-2)	4.6555e-1 (6.80e-2)	4.9113e-1 (7.81e-2)	7.8741e-1 (8.39e-2)
CF8	3	10	3.3644e-1 (6.93e-2)	6.0100e-1 (9.12e-2)	1.6744e-1 (5.65e-2)	3.2883e-1 (5.62e-2)	3.4228e-1 (9.03e-2)	2.9181e-1 (8.36e-2)	3.4842e-1 (3.26e-2)	7.0144e-1 (5.24e-2)
CF9	3	10	4.2476e-1 (3.56e-2)	7.5899e-1 (1.09e-2)	3.22219e-1 (5.28e-2)	4.3318e-1 (9.72e-3)	3.8758e-1 (6.84e-2)	4.1952e-1 (4.73e-2)	4.3326e-1 (1.54e-2)	8.2538e-1 (1.49e-2)
CF10	3	10	1.8712e-1 (1.12e-1)	3.1558e-1 (6.78e-2)	1.2337e-1 (7.32e-2)	1.6590e-1 (4.23e-2)	1.4336e-1 (8.71e-2)	1.4907e-1 (7.23e-2)	2.4501e-1 (5.26e-1)	5.2650e-1 (1.49e-1)
DASCMOP1	2	30	1.0659e-2 (8.35e-3)	1.0443e-1 (5.56e-3)	8.7112e-2 (9.39e-2)	2.1227e-1 (4.80e-4)	6.7241e-3 (8.43e-3)	1.9265e-2 (1.41e-2)	2.5725e-2 (2.20e-2)	3.6190e-1 (4.94e-4)
DASCMOP2	2	30	2.5415e-1 (3.30e-3)	3.9006e-1 (3.99e-3)	2.7876e-1 (2.59e-2)	3.5532e-1 (1.24e-4)	1.1006e-1 (1.05e-1)	2.7151e-1 (3.17e-3)	2.7153e-1 (8.04e-3)	5.0505e-1 (4.86e-5)
DASCMOP3	2	30	2.1365e-1 (6.91e-3)	3.3321e-1 (2.14e-2)	2.1483e-1 (1.53e-2)	3.1217e-1 (2.14e-4)	1.3876e-1 (8.99e-2)	2.1613e-1 (1.07e-3)	2.3867e-1 (2.02e-2)	4.5537e-1 (1.81e-4)
DASCMOP4	2	30	2.0212e-1 (1.01e-2)	3.4772e-1 (7.59e-5)	2.0409e-1 (1.28e-4)	2.0341e-1 (1.57e-3)	1.8850e-1 (4.41e-2)	2.0430e-1 (6.46e-5)	2.0393e-1 (1.61e-4)	3.4734e-1 (2.58e-4)
DASCMOP5	2	30	3.4358e-1 (4.32e-2)	4.9949e-1 (6.76e-5)	3.5147e-1 (1.13e-4)	3.2965e-1 (7.80e-2)	3.4316e-1 (6.51e-3)	3.5172e-1 (5.76e-5)	3.5136e-1 (1.71e-4)	4.59902e-1 (2.16e-4)
DASCMOP6	2	30	2.6814e-1 (7.39e-2)	4.4819e-1 (1.75e-2)	3.1241e-1 (1.28e-4)	2.8655e-1 (7.12e-2)	2.8104e-1 (1.94e-2)	3.0924e-1 (9.56e-3)	3.0527e-1 (3.87e-2)	4.5543e-1 (8.59e-5)
DASCMOP7	3	30	2.8785e-1 (4.59e-4)	4.5503e-1 (4.59e-4)	2.8735e-1 (3.10e-4)	2.7298e-1 (3.12e-2)	2.8686e-1 (5.55e-4)	2.8866e-1 (2.66e-4)	2.8716e-1 (5.33e-4)	4.5429e-1 (4.42e-4)
DASCMOP8	3	30	2.0662e-1 (5.42e-4)	3.7388e-1 (4.27e-4)	2.0606e-1 (3.59e-4)	1.6044e-1 (6.94e-2)	7.3167e-2 (8.06e-2)	2.0746e-1 (4.33e-4)	2.0603e-1 (4.48e-4)	3.7420e-1 (4.17e-4)
DASCMOP9	3	30	1.3185e-1 (8.00e-3)	3.3518e-1 (2.57e-2)	1.9857e-1 (1.89e-2)	2.0499e-1 (5.44e-2)	7.3839e-2 (5.03e-2)	1.4877e-1 (4.54e-2)	1.4631e-1 (1.30e-2)	3.7464e-1 (3.30e-4)
LIRCMOP1	2	30	1.4673e-1 (5.70e-3)	2.9337e-1 (2.03e-2)	1.4088e-1 (2.06e-2)	1.9403e-1 (2.70e-2)	1.1704e-1 (1.14e-2)	1.8121e-1 (1.02e-2)	1.7345e-1 (8.86e-3)	3.8637e-1 (3.23e-4)
LIRCMOP2	2	30	2.6931e-1 (8.68e-3)	4.3679e-1 (1.19e-2)	2.6033e-1 (1.60e-2)	3.3091e-1 (2.80e-2)	2.4249e-1 (1.13e-2)	3.0357e-1 (9.09e-3)	3.2017e-1 (8.84e-3)	5.0860e-1 (3.85e-4)
LIRCMOP3	2	30	1.3501e-1 (6.87e-3)	2.3284e-1 (1.75e-2)	1.1558e-1 (1.47e-2)	1.6985e-1 (2.01e-2)	1.1027e-1 (1.19e-2)	1.5597e-1 (8.86e-3)	1.7685e-1 (1.03e-2)	3.4810e-1 (4.62e-4)
LIRCMOP4	2	30	2.3139e-1 (1.11e-2)	3.5488e-1 (2.07e-2)	2.0758e-1 (2.05e-2)	2.6566e-1 (2.43e-2)	2.0995e-1 (1.52e-2)	2.5789e-1 (1.18e-2)	2.7673e-1 (1.05e-2)	4.5933e-1 (6.57e-4)
LIRCMOP5	2	30	0.0000e+0 (0.00e+0)	2.4816e-1 (3.81e-2)	2.8464e-1 (1.55e-2)	2.9001e-1 (8.87e-4)	1.4827e-1 (2.49e-2)	1.3153e-1 (5.09e-2)	1.7531e-1 (3.01e-2)	4.2595e-1 (3.13e-4)
LIRCMOP6	2	30	0.0000e+0 (0.00e+0)	1.8604e-1 (1.81e-2)	1.8621e-1 (1.88e-2)	1.9582e-1 (4.33e-4)	9.3832e-2 (8.00e-3)	8.7546e-2 (5.02e-2)	1.2662e-1 (2.68e-2)	3.3132e-1 (1.69e-4)
LIRCMOP7	2	30	2.1258e-1 (8.51e-2)	3.7621e-1 (1.36e-2)	2.7357e-1 (2.03e-2)	2.9296e-1 (5.69e-3)	2.4054e-1 (8.40e-3)	2.4776e-1 (9.43e-3)	2.5731e-1 (9.62e-3)	4.5088e-1 (1.04e-3)
LIRCMOP8	2	30	1.2455e-1 (1.12e-1)	3.6011e-1 (2.02e-2)	2.8878e-1 (1.32e-2)	2.9425e-1 (2.23e-4)	2.2070e-1 (4.05e-3)	2.3642e-1 (1.11e-2)	2.4976e-1 (1.44e-2)	4.5119e-1 (1.22e-4)
LIRCMOP9	2	30	1.4900e-1 (7.62e-2)	6.6079e-1 (5.05e-2)	4.0803e-1 (5.03e-2)	5.5951e-1 (6.49e-3)	1.9483e-1 (6.03e-2)	2.7367e-1 (8.32e-2)	4.4013e-1 (2.80e-2)	7.5808e-1 (8.66e-3)
LIRCMOP10	2	30	7.8527e-2 (2.20e-2)	8.2283e-1 (2.60e-2)	6.0753e-1 (3.99e-2)	7.0539e-1 (4.08e-4)	3.4640e-1 (7.23e-2)	5.7112e-1 (1.36e-1)	6.2278e-1 (1.92e-2)	9.1603e-1 (2.22e-4)
LIRCMOP11	2	30	4.0405e-1 (1.47e-1)	8.7766e-1 (2.34e-2)	6.4543e-1 (4.14e-2)	6.9361e-1 (2.04e-4)	3.3943e-1 (1.01e-1)	5.5709e-1 (1.39e-1)	6.4552e-1 (2.66e-2)	9.0393e-1 (1.61e-4)
LIRCMOP12	2	30	4.5797e-1 (8.25e-2)	7.6833e-1 (3.56e-2)	5.2153e-1 (4.12e-2)	6.1965e-1 (5.04e-4)	3.7883e-1 (3.47e-2)	4.8564e-1 (4.39e-2)	5.2883e-1 (2.41e-2)	8.3011e-1 (2.22e-4)
LIRCMOP13	3	30	1.0805e-4 (1.13e-4)	8.8648e-1 (1.24e-3)	5.5227e-1 (1.44e-3)	5.0885e-1 (2.92e-3)	4.5037e-4 (4.03e-6)	9.7134e-5 (1.14e-4)	5.5172e-1 (1.62e-3)	8.6676e-1 (2.80e-3)
LIRCMOP14	3	30	3.6873e-4 (2.90e-4)	8.8528e-1 (1.81e-3)	5.4441e-1 (1.58e-3)	5.3998e-1 (1.82e-3)	9.9870e-4 (1.13e-5)	5.3374e-4 (2.94e-4)	5.5553e-1 (1.15e-3)	8.2287e-1 (2.23e-1)

+/-=

0/33/0

5/28/0

0/33/0

0/33/0

0/33/0

0/33/0

0/33/0

0/33/0

0/33/0

0

TABLE SII

THE AVERAGE HV RESULTS OBTAINED BY ACEMT AND ITS SEVEN NON-CEMT-BASED COMPETITORS ON THREE TEST BENCHMARK SUITES.

Problem	M	D	c-DPEA	CMME	CMOEA-MS	DSPCMDE	MSCMO	Ship+	URCMO	ACEMT
CF1	2	10	5.6143e-1 (5.26e-4)	7.6188e-1 (3.20e-3)	5.7549e-1 (1.69e-2)	5.6209e-1 (9.17e-4)	5.5753e-1 (1.53e-3)	7.6944e-1 (8.23e-4)	5.6326e-1 (3.95e-4)	7.7451e-1 (2.34e-4)
CF2	2	10	6.4761e-1 (1.75e-2)	8.2440e-1 (4.27e-2)	7.9838e-1 (3.67e-2)	6.7207e-1 (2.39e-3)	6.3942e-1 (1.76e-2)	8.3099e-1 (2.13e-2)	6.7517e-1 (1.34e-3)	8.8854e-1 (2.74e-4)
CF3	2	10	1.9503e-1 (4.51e-2)	3.2400e-1 (6.24e-2)	3.4252e-1 (4.68e-2)	2.8946e-1 (2.31e-2)	1.8907e-1 (3.71e-2)	3.5156e-1 (6.30e-2)	2.0992e-1 (6.22e-2)	4.3815e-1 (5.99e-2)
CF4	2	10	4.3546e-1 (3.41e-2)	5.7911e-1 (5.87e-2)	5.6340e-1 (5.53e-2)	4.7287e-1 (8.91e-3)	4.1082e-1 (4.29e-2)	6.1094e-1 (3.09e-2)	5.0211e-1 (1.21e-2)	7.1393e-1 (3.01e-2)
CF5	2	10	2.6555e-1 (8.06e-2)	3.4422e-1 (8.47e-2)	3.9689e-1 (8.03e-2)	3.2403e-1 (1.11e-1)	3.0142e-1 (4.73e-2)	4.3388e-1 (9.50e-2)	3.5616e-1 (7.77e-2)	6.0508e-1 (3.82e-2)
CF6	2	10	6.6227e-1 (2.16e-2)	8.3812e-1 (1.79e-2)	8.2008e-1 (1.15e-2)	6.7980e-1 (3.69e-3)	4.1082e-1 (8.91e-3)	6.6096e-1 (7.86e-2)	8.5978e-1 (1.78e-2)	4.5537e-1 (1.81e-4)
CF7	2	10	4.5332e-1 (9.39e-2)	5.3448e-1 (1.40e-2)	5.6320e-1 (8.07e-2)	5.2980e-1 (9.05e-2)	4.3399e-1 (7.63e-2)	6.1367e-1 (1.10e-1)	6.2278e-1 (1.92e-2)	3.4810e-1 (4.62e-4)
CF8	3	10	3.2752e-1 (2.25e-2)	5.7996e-1 (1.05e-2)	6.1832e-1 (6.48e-2)	3.5540e-1 (2.00e-4)	2.4613e-1 (1.61e-2)	6.2413e-1 (6.41e-2)	5.7112e-1 (1.32e-2)	7.0144e-1 (5.24e-2)
CF9	3	10	4.3176e-1 (7.90e-3)	7.4248e-1 (4.82e-2)	7.0536e-1 (6.63e-2)	4.6161e-1 (1.11e-2)	3.9645e-1 (6.04e-2)	7.7162e-1 (1.25e-2)	4.4518e-1 (8.83e-3)	8.2538e-1 (1.49e-2)
CF10	3	10	1.4323e-1 (3.95e-2)	3.2990e-1 (1.70e-1)	3.8725e-1 (1.56e-1)	1.9710e-1 (8.13e-2)	1.4357e-1 (4.70e-2)	2.7107e-1 (1.14e-1)	2.4517e-1 (9.81e-2)	5.2650e-1 (1.49e-1)
DASCMOP1	2	30	2.6862e-2 (5.16e-2)	7.7602e-1 (2.51e-2)	2.1177e-1 (2.76e-2)	5.2117e-1 (4.85e-4)	2.8844e-2 (1.27e-2)	3.6152e-1 (4.85e-4)	2.1261e-1 (2.90e-4)	3.6190e-1 (4.94e-4)
DASCMOP2	2	30	2.6405e-1 (3.16e-3)	3.7099e-1 (8.20e-3)	3.7252e-1 (6.50e-3)	3.5481e-1 (8.75e-5)	2.6921e-1 (3.39e-3)	4.9557e-1 (1.00e-2)	3.5512e-1 (1.12e-4)	5.0505e-1 (4.86e-5)
DASCMOP3	2	30	2.2594e-1 (1.61e-2)	3.1283e-1 (1.03e-2)	3.1113e-1 (2.99e-3)	3.1165e-1 (4.02e-4)	2.2235e-1 (1.47e-2)	3.7751e-1 (1.29e-2)	2.3955e-1 (4.60e-2)	4.5537e-1 (1.81e-4)
DASCMOP4	2	30	2.0350e-1 (2.15e-3)	3.2162e-1 (4.42e-2)	3.4224e-1 (2.00e-2)	4.2688e-2 (7.79e-2)	2.0429e-1 (2.05e-3)	3.4647e-1 (2.05e-3)	2.0387e-1 (2.79e-4)	3.4734e-1 (2.58e-4)
DASCMOP5	2	30	3.5120e-1 (2.91e-2)	4.7784e-1 (7.07e-2)	4.9137e-1 (1.50e-1)	3.5158e-1 (1.15e-4)	3.0518e-1 (1.51e-4)	3.5129e-1 (2.36e-4)	4.9902e-1 (2.16e-4)	
DASCMOP7	3	30	2.8744e-1 (4.94e-4)	4.4529e-1 (4.78e-4)	4.4455e-1 (4.55e-2)	1.3616e-1 (1.32e-1)	2.8795e-1 (3.75e-4)	4.4941e-1 (6.		

TABLE SIII

THE AVERAGE IGD+ RESULTS OBTAINED BY ACEMT AND ITS SEVEN CEMT-BASED COMPETITORS ON THREE TEST BENCHMARK SUITES.

Problem	M	D	BiCo	CMEGL	CMOEMT	MCCMO	MFO-MOEAI	MTCMO	TPEA	ACEMT
CF1	2	10	9.0423e-3 (1.24e-3) -	2.6842e-3 (2.47e-4) -	8.2219e-4 (1.90e-4) +	4.5769e-3 (4.81e-4) -	2.9888e-3 (6.47e-4) -	3.6902e-3 (6.93e-4) -	4.0723e-3 (4.78e-4) -	1.3143e-3 (1.92e-4)
CF2	2	10	2.9736e-2 (1.10e-2) -	1.9865e-2 (6.36e-3) -	3.3990e-3 (1.25e-3) -	1.9836e-2 (7.34e-3) -	8.8226e-2 (3.47e-2) -	2.3478e-2 (1.03e-2) -	1.5801e-2 (7.61e-3) -	2.2351e-3 (9.90e-5)
CF3	2	10	2.2070e-1 (9.71e-2) -	1.7845e-1 (6.37e-2) =	1.8214e-1 (6.54e-2) =	2.1042e-1 (5.63e-2) -	3.8434e-1 (1.60e-1) -	2.2756e-1 (5.38e-2) -	1.8604e-1 (5.11e-2) -	1.4911e-1 (6.74e-2)
CF4	2	10	7.3177e-2 (3.01e-2) -	7.3712e-2 (2.46e-2) -	2.5546e-2 (7.50e-3) -	6.0212e-2 (2.14e-2) -	1.6154e-1 (7.80e-2) -	7.6697e-2 (2.60e-2) -	5.5491e-2 (2.31e-2) -	1.4906e-2 (5.31e-3)
CF5	2	10	2.1232e-1 (9.96e-2) -	1.9061e-1 (7.08e-2) -	1.3097e-1 (7.13e-2) -	1.8405e-1 (8.51e-2) -	2.8649e-1 (6.94e-2) -	2.2389e-1 (1.02e-1) -	1.7552e-1 (5.27e-2) -	7.5617e-2 (2.65e-2)
CF6	2	10	4.7716e-2 (1.66e-2) -	3.3769e-2 (1.31e-2) -	1.8510e-2 (6.08e-3) -	3.1267e-2 (1.18e-2) -	1.2151e-1 (4.89e-2) -	3.3187e-2 (1.05e-2) -	2.4362e-2 (8.03e-3) -	9.4677e-3 (9.39e-4)
CF7	2	10	1.5785e-1 (7.83e-2) -	1.7930e-1 (8.75e-2) -	1.6906e-1 (7.01e-2) -	1.5755e-1 (8.27e-2) -	2.6793e-1 (1.14e-1) -	1.6885e-1 (7.43e-2) -	1.2782e-1 (5.51e-2) -	6.7061e-2 (4.83e-2)
CF8	3	10	1.4017e-1 (6.53e-2) -	1.4716e-1 (3.95e-2) -	2.3896e-1 (6.34e-2) -	1.3452e-1 (3.30e-2) -	1.6065e-1 (1.21e-1) -	1.6267e-1 (7.00e-2) -	1.3178e-1 (2.16e-2) -	1.0607e-1 (2.35e-2)
CF9	3	10	6.2151e-2 (1.46e-2) -	6.1512e-2 (3.18e-3) -	1.2467e-1 (4.43e-2) -	5.9146e-2 (3.10e-3) -	9.0296e-2 (8.23e-2) -	6.3348e-2 (2.00e-2) -	6.1521e-2 (4.91e-3) -	4.3226e-2 (5.89e-3)
CF10	3	10	3.7734e-1 (2.89e-1) -	2.7931e-1 (6.78e-2) -	3.5578e-1 (2.02e-2) -	2.7988e-1 (1.41e-2) -	3.5374e-1 (9.29e-2) -	3.1009e-1 (1.23e-1) -	2.0209e-1 (1.35e-1) -	1.7215e-1 (7.75e-2)
DASCMOP1	2	30	7.0801e-1 (4.60e-2) -	5.6659e-1 (1.25e-1) -	4.3399e-1 (3.29e-1) -	1.8094e-3 (9.24e-5) -	7.3408e-1 (4.96e-2) -	6.6340e-1 (5.69e-2) -	6.3874e-1 (8.76e-2) -	1.4824e-3 (7.17e-5)
DASCMOP2	2	30	4.0070e-1 (6.01e-3) -	1.2670e-1 (1.64e-2) -	1.0920e-1 (4.05e-2) -	3.2577e-3 (1.54e-4) -	5.2133e-1 (2.73e-1) -	1.2926e-1 (1.01e-2) -	1.2174e-1 (1.45e-2) -	2.6970e-3 (7.82e-5)
DASCMOP3	2	30	1.8440e-1 (1.95e-2) -	1.6331e-1 (2.92e-2) -	1.8055e-1 (2.34e-2) -	5.3785e-3 (1.06e-4) -	3.9235e-1 (2.53e-1) -	1.7725e-1 (1.04e-2) -	1.4079e-1 (3.69e-2) -	5.2672e-3 (8.46e-5)
DASCMOP4	2	30	2.8201e-3 (1.14e-2) -	6.3728e-4 (2.21e-5) +	7.1804e-4 (2.87e-5) -	9.5540e-4 (4.02e-4) -	5.0331e-2 (1.60e-1) -	6.3608e-4 (2.04e-5) +	8.4491e-4 (7.61e-5) -	6.8360e-4 (3.81e-5)
DASCMOP5	2	30	1.4847e-2 (7.06e-2) -	1.7392e-2 (5.90e-5) +	1.9312e-3 (8.92e-5) =	4.5462e-2 (1.60e-1) -	1.1223e-2 (9.24e-3) -	7.1715e-3 (3.32e-5) +	1.9684e-3 (1.28e-4) =	1.9304e-3 (1.01e-4)
DASCMOP6	2	30	7.6739e-2 (1.29e-1) -	1.1225e-2 (1.74e-2) -	5.2251e-3 (5.32e-5) +	5.6722e-2 (1.75e-1) -	5.2196e-2 (3.65e-2) -	9.7767e-3 (1.44e-2) -	1.7942e-2 (6.95e-2) -	5.2852e-3 (9.25e-5)
DASCMOP7	3	30	2.4728e-2 (1.04e-3) -	2.3492e-2 (9.34e-4) -	2.4992e-2 (8.53e-4) -	5.1499e-2 (6.73e-2) -	2.7747e-2 (8.50e-4) -	2.3100e-2 (7.24e-4) =	2.5828e-2 (1.21e-3) -	2.2977e-2 (8.26e-4)
DASCMOP8	3	30	1.9127e-2 (8.95e-4) -	1.8720e-2 (8.77e-4) -	1.8694e-2 (7.44e-4) -	1.3325e-1 (2.05e-1) -	4.8227e-1 (3.20e-1) -	1.8339e-2 (7.81e-4) -	2.0677e-2 (9.90e-4) -	1.7496e-2 (7.19e-4)
DASCMOP9	3	30	2.3009e-1 (2.73e-2) -	8.4051e-2 (5.27e-2) -	2.1083e-2 (1.03e-3) -	4.3968e-1 (1.71e-1) -	4.3986e-1 (4.33e-2) -	1.9386e-1 (3.61e-2) -	1.8648e-1 (4.33e-2) -	1.6794e-2 (5.45e-4)
LIRCMOP1	2	30	1.6297e-1 (1.15e-2) -	8.5668e-2 (2.08e-2) -	1.8395e-1 (4.57e-2) -	7.0719e-2 (4.71e-2) -	2.3728e-1 (2.18e-2) -	9.2820e-2 (1.78e-2) -	1.0592e-1 (1.73e-2) -	5.3125e-3 (4.12e-4)
LIRCMOP2	2	30	9.8409e-2 (1.09e-2) -	5.1054e-2 (9.60e-3) -	1.1268e-1 (2.37e-2) -	3.0153e-2 (2.66e-2) -	1.4658e-1 (1.35e-2) -	5.8336e-2 (9.00e-3) -	3.6184e-2 (8.25e-3) -	5.6333e-3 (4.90e-4)
LIRCMOP3	2	30	1.6166e-1 (1.92e-2) -	1.4723e-1 (2.91e-2) -	2.1495e-1 (3.65e-2) -	7.9923e-2 (5.20e-2) -	2.3727e-1 (2.60e-2) -	1.1084e-1 (2.21e-2) -	6.4034e-2 (2.12e-2) -	2.9595e-3 (5.30e-4)
LIRCMOP4	2	30	1.1782e-1 (1.67e-2) -	1.0063e-1 (2.37e-2) -	1.5866e-1 (3.49e-2) -	6.8595e-2 (3.54e-2) -	1.5857e-1 (2.53e-2) -	7.7919e-2 (1.57e-2) -	4.9872e-2 (1.30e-2) -	3.7074e-3 (6.85e-4)
LIRCMOP5	2	30	1.2194e+0 (6.92e-3) -	2.3116e-1 (8.23e-2) -	1.6269e-2 (2.32e-2) -	8.8900e-3 (2.02e-3) -	2.4373e-1 (6.09e-2) -	3.4439e-1 (2.99e-1) -	1.8415e-1 (6.29e-2) -	6.3832e-3 (5.44e-4)
LIRCMOP6	2	30	1.3453e+0 (1.51e-4) -	2.8288e-1 (5.53e-2) -	4.1357e-2 (6.81e-2) -	6.9991e-3 (8.28e-4) -	3.0328e-1 (4.22e-2) -	5.1259e-1 (4.68e-1) -	2.2496e-1 (2.18e-1) -	5.8269e-3 (3.37e-4)
LIRCMOP7	2	30	3.1816e-1 (5.44e-1) -	9.8948e-2 (2.63e-2) -	4.7079e-2 (4.14e-2) -	8.6666e-3 (1.11e-2) -	1.2125e-1 (1.99e-2) -	1.0196e-1 (2.31e-2) -	7.7950e-2 (2.36e-2) -	5.2835e-3 (5.77e-4)
LIRCMOP8	2	30	8.4654e-1 (7.44e-1) -	1.4751e-1 (5.34e-2) -	1.6947e-2 (2.67e-2) -	5.9259e-3 (3.12e-4) -	2.1465e-1 (3.39e-2) -	1.4965e-1 (4.08e-2) -	1.0762e-1 (4.44e-2) -	5.1441e-3 (2.57e-4)
LIRCMOP9	2	30	8.5876e-1 (2.08e-1) -	2.0136e-1 (9.42e-2) -	2.3578e-1 (4.87e-2) -	1.3935e-2 (1.49e-2) +	8.3382e-1 (1.67e-1) -	5.3973e-1 (1.64e-1) -	2.1039e-1 (4.71e-2) -	4.1413e-2 (2.07e-2)
LIRCMOP10	2	30	8.6293e-1 (6.78e-2) -	1.4251e-1 (3.61e-2) -	1.6302e-1 (5.67e-2) -	6.8788e-3 (6.34e-4) -	4.2983e-1 (1.21e-1) -	1.9351e-1 (1.70e-1) -	1.2088e-1 (2.92e-2) -	5.8511e-3 (3.23e-4)
LIRCMOP11	2	30	4.1117e-1 (2.27e-1) -	3.8637e-2 (3.11e-2) -	6.5616e-2 (5.10e-2) -	1.3001e-3 (3.01e-4) -	6.5415e-1 (1.82e-1) -	1.9772e-1 (1.86e-1) -	7.2262e-2 (2.75e-2) -	7.4322e-4 (2.60e-4)
LIRCMOP12	2	30	3.3572e-1 (1.79e-1) -	1.0686e-1 (5.24e-2) -	1.5681e-1 (5.74e-2) -	1.9333e-3 (1.04e-3) -	6.4045e-1 (7.84e-2) -	2.4791e-1 (1.07e-1) -	1.5103e-1 (3.31e-2) -	1.0198e-3 (5.31e-4)
LIRCMOP13	3	30	1.3180e+0 (2.11e-3) -	4.3551e-2 (1.13e-3) +	4.6233e-2 (1.36e-3) +	9.1920e-2 (3.03e-3) -	1.3015e+0 (9.83e-5) -	1.3141e+0 (1.86e-3) -	4.7863e-2 (1.73e-3) +	6.1570e-2 (2.72e-3)
LIRCMOP14	3	30	1.2737e+0 (1.85e-3) -	4.6019e-2 (1.55e-3) +	5.5221e-2 (1.66e-3) +	6.0639e-2 (2.14e-3) +	1.2575e+0 (1.04e-4) -	4.5042e-2 (1.19e-3) +	1.3008e-1 (3.08e-1) -	
+/-=										
			0/31/2	4/27/2	4/27/2	2/31/0	0/32/1	2/29/2	2/28/3	

TABLE SIV

THE AVERAGE IGD+ RESULTS OBTAINED BY ACEMT AND ITS SEVEN NON-CEMT-BASED COMPETITORS ON THREE TEST BENCHMARK SUITES.

Problem	M	D	c-DPEA	CMME	CMOEA-MS	DSPCMDE	MSCMO	ShiP ⁺	URCMO	ACEMT
CF1	2	10	3.7721e-3 (4.30e-4) -	1.0408e-2 (1.91e-3) -	1.4254e-3 (1.07e-2) -	3.3125e-3 (7.60e-4) -	6.8968e-3 (1.14e-3) -	5.3100e-3 (6.39e-4) -	2.3305e-3 (3.10e-4) -	1.3143e-3 (1.92e-4)
CF2	2	10	1.9722e-2 (8.87e-3) -	3.0159e-2 (1.63e-2) -	4.7821e-2 (3.43e-2) -	5.5229e-3 (2.03e-3) -	2.4841e-2 (1.40e-2) -	2.8323e-2 (7.94e-3) -	4.4824e-3 (4.95e-4) -	2.2351e-3 (9.90e-5)
CF3	2	10	2.0162e-1 (6.79e-2) -	2.3293e-1 (8.29e-2) -	2.1726e-1 (8.01e-2) -	7.6368e-2 (2.37e-2) +	2.0124e-1 (5.91e-2) -	2.2285e-1 (1.02e-1) -	1.8474e-1 (9.54e-2) -	1.4911e-1 (6.74e-2)
CF4	2	10	6.3597e-2 (2.29e-2) -	8.9770e-2 (4.35e-2) -	9.9561e-2 (4.50e-2) -	4.1638e-2 (2.59e-3) -	8.1045e-2 (2.92e-2) -	7.0513e-2 (2.01e-2) -	2.2669e-2 (7.46e-3) -	1.4906e-2 (5.31e-2)
CF5	2	10	2.4437e-1 (1.07e-1) -	2.9780e-2 (9.82e-2) -	2.3991e-1 (8.75e-2) -	1.8061e-1 (1.13e-1) -	1.8971e-1 (6.21e-2) -	2.1147e-1 (9.88e-2) -	1.4987e-1 (8.75e-2) -	5.2835e-3 (5.77e-4)
CF6	2	10	2.9027e-2 (1.20e-2) -	4.3561e-2 (1.38e-2) -	5.6999e-2 (1.01e-2) -	1.8414e-2 (3.23e-3) -	3.0066e-2 (8.03e-2) -	2.9526e-2 (1.30e-2) -	1.4885e-2 (2.83e-3) -	9.4677e-3 (9.39e-4)
CF7	2	10	1.6912e-1 (9.60e-2) -	2.4435e-1 (1.48e-1) -	2.2665e-1 (8.32e-2) -	1.2247e-1 (9.81e-2) -	1.7091e-1 (5.86e-2) -	1.7468e-1 (9.32e-2) -	1.2210e-1 (0.99e-2) -	6.7061e-2 (4.83e-2)
CF8	3	10	1.3326e-1 (3.60e-2) -	2.3019e-1 (1.31e-2) -	1.4563e-1 (2.16e-2) -	1.3247e-2 (1.26e-2) -	2.5648e-2 (1.26e-2) -	1.0103e-1 (0.93e-2) -	1.0880e-1 (8.73e-3) -	1.0607e-2 (2.35e-2)
CF9	3	10	5.8117e-2 (3.51e-3) -	5.9834e-2 (1.42e-2) -	7.0350e-2 (1.86e-2) -	7.7292e-2 (1.33e-2) -	8.0596e-2 (3.84e-2) -	4.3372e-2 (2.73e-3) -	5.2470e-2 (2.61e-3) -	4.3226e-2 (5.89e-3)
CF10	3	10	3.0760e-1 (9.55e-2) -	3.1482e-1 (1.61e-1) -	2.8875e-1 (1.68e-1) -	2.5180e-1 (8.23e-2) -	3.2204e-1 (1.92e-1) -	3.7062e-1 (1.34e-1) -	1.8011e-1 (8.93e-2) -	1.7215e-1 (7.75e-2)
DASCMOP1	2	30	6.3180e-1 (1.01e-1) -	4.6392e-1 (2.10e-2) -	7.1009e-2 (1.30e-2) -	2.1023e-2 (1.07e-2) -	2.0439e-1 (0.79e-3) -	1.8022e-2 (7.13e-5) -	1.4824e-2 (7.15e-5)	
DASCMOP2	2	30	1.3320e-1 (1.09e-2) -	1.4615e-1 (1.34e-2) -	1.4293e-1 (1.30e-2) -	3.7928e-3 (1.02e-4) -	1.2958e-1 (1.16e-2) -	9.8071e-3 (7.95e-3) -	4.4824e-3 (4.95e-4) -	2.2351e-3 (9.90e-5)
DASCMOP3	2	30	1.5868e-1 (2.69e-2) -	1.8777e-1 (1.35e-2) -	1.9397e-1 (1.23e-2) -	5.9207e-3 (3.40e-4) -	1.6824e-1 (2.83e-2) -	1.0315e-1 (1.54e-2) -	1.3578e-1 (8.18e-2) -	5.2672e-3 (8.46e-5)
DASCMOP4	2	30	8.3491e-4 (4.79e-4) =	5.7227e						

TABLE SV
THE AVERAGE IGD RESULTS OBTAINED BY ACEM^T WITH DIFFERENT α ON THREE TEST BENCHMARK SUITES.

TABLE SVI
THE AVERAGE HV RESULTS OBTAINED BY ACEM^I WITH DIFFERENT α ON THREE TEST BENCHMARK SUITES.

TABLE VIII
THE AVERAGE IGD RESULTS OBTAINED BY ACEMT WITH DIFFERENT Δ ON THREE TEST BENCHMARK SUITES.

Problem	M	D	$\Delta = 10$	$\Delta = 20$	$\Delta = 30$	$\Delta = 40$	$\Delta = 50$	$\Delta = 70$	$\Delta = 80$	$\Delta = 90$	$\Delta = 100$	$\Delta = 60$ (ACEMT)
CF1	2	10	1.1883e-3 (1.93e-4)	1.1805e-3 (1.72e-4)	1.1824e-3 (1.75e-4)	1.1183e-3 (1.58e-4)	1.1038e-3 (1.90e-4)	1.1790e-3 (1.68e-4)	1.1908e-3 (1.69e-4)	1.1579e-3 (1.69e-4)	1.1090e-3 (1.93e-4)	1.1828e-3 (1.81e-4)
CF2	2	10	2.7056e-3 (9.75e-5)	2.6929e-3 (8.52e-5)	2.6719e-3 (8.95e-5)	2.6962e-3 (8.51e-5)	2.6876e-3 (7.56e-5)	2.6955e-3 (9.01e-5)	2.6909e-3 (7.67e-5)	2.6893e-3 (7.23e-5)	2.7073e-3 (9.47e-5)	2.6861e-3 (7.20e-5)
CF3	2	10	1.7940e-1 (7.45e-2)	1.8831e-1 (9.75e-2)	1.9305e-1 (7.81e-2)	2.1106e-1 (1.08e-1)	2.3492e-1 (9.75e-2)	2.2319e-1 (1.14e-1)	1.7849e-1 (8.64e-2)	2.1150e-1 (1.14e-1)	1.9391e-1 (1.08e-1)	2.0476e-1 (8.22e-2)
CF4	2	10	1.7672e-2 (7.34e-3)	1.8678e-2 (6.70e-3)	1.5954e-2 (4.74e-3)	1.7520e-2 (7.30e-3)	1.8268e-2 (6.81e-3)	1.5800e-2 (4.69e-3)	1.9271e-2 (8.20e-3)	1.7664e-2 (5.41e-3)	1.7704e-2 (5.87e-3)	1.7430e-2 (6.32e-3)
CF5	2	10	1.0715e-1 (4.98e-2)	1.1871e-1 (7.04e-2)	1.2354e-1 (8.04e-2)	1.2963e-1 (8.64e-2)	1.1655e-1 (8.98e-2)	1.2250e-1 (8.10e-2)	1.2200e-1 (7.94e-2)	1.2116e-1 (7.19e-2)	1.1631e-1 (8.14e-2)	9.5723e-2 (3.78e-2)
CF6	2	10	1.3622e-2 (2.31e-3)	1.4605e-2 (2.92e-3)	1.3976e-2 (3.54e-3)	1.4856e-2 (2.67e-3)	1.3525e-2 (2.58e-3)	1.4856e-2 (3.03e-3)	1.4221e-2 (2.53e-3)	1.4216e-2 (2.71e-3)	1.4052e-2 (2.86e-3)	1.4800e-2 (3.22e-3)
CF7	2	10	8.7481e-2 (5.77e-2)	8.4165e-2 (5.21e-2)	9.5477e-2 (5.73e-2)	1.2239e-1 (9.41e-2)	1.1193e-1 (8.95e-2)	9.0758e-2 (5.10e-2)	9.0602e-2 (6.14e-2)	9.0399e-2 (5.20e-2)	9.3848e-2 (4.52e-2)	1.1904e-1 (1.04e-1)
CF8	3	10	1.5905e-1 (4.66e-2)	1.5031e-1 (2.86e-2)	1.4268e-1 (1.64e-2)	1.4353e-1 (2.89e-2)	1.4326e-1 (2.08e-2)	1.3943e-1 (1.69e-2)	1.4346e-1 (1.96e-2)	1.3639e-1 (2.69e-2)	1.4045e-1 (1.63e-2)	1.4320e-1 (3.14e-2)
CF9	3	10	7.5555e-2 (9.87e-3)	7.2273e-2 (6.60e-3)	7.3681e-2 (1.07e-2)	7.5962e-2 (1.15e-2)	7.3141e-2 (9.69e-3)	7.4653e-2 (1.33e-2)	7.3630e-2 (1.25e-2)	7.1464e-2 (7.36e-3)	6.9616e-2 (4.97e-3)	7.4111e-2 (1.27e-2)
CF10	3	10	2.0513e-1 (8.88e-2)	2.3057e-1 (1.08e-1)	2.1018e-1 (1.07e-1)	1.9364e-1 (8.52e-2)	2.2933e-1 (1.00e-1)	2.0465e-1 (1.02e-1)	2.0633e-1 (1.05e-1)	2.2010e-1 (1.12e-1)	2.0447e-1 (8.47e-2)	2.1604e-1 (9.03e-2)
DASCMP01	2	30	2.9541e-3 (1.79e-4)	3.0567e-3 (2.53e-4)	2.9680e-3 (5.22e-4)	3.0173e-3 (2.82e-4)	3.0116e-3 (2.33e-4)	3.0029e-3 (2.67e-4)	2.9819e-3 (2.17e-4)	3.0421e-3 (2.43e-4)	3.0747e-3 (2.53e-4)	2.9741e-3 (1.95e-4)
DASCMP02	2	30	3.9384e-3 (4.66e-5)	3.9555e-3 (6.34e-5)	3.9638e-3 (6.49e-5)	3.9414e-3 (7.60e-5)	3.9536e-3 (6.47e-5)	3.9687e-3 (8.29e-5)	3.9560e-3 (6.06e-5)	3.9381e-3 (7.36e-5)	3.9543e-3 (5.45e-5)	3.9638e-3 (6.97e-5)
DASCMP03	2	30	1.7481e-2 (3.26e-3)	1.6798e-2 (3.45e-3)	1.6996e-2 (3.37e-3)	1.7295e-2 (3.31e-3)	1.7400e-2 (3.25e-3)	1.7076e-2 (3.34e-3)	1.7577e-2 (3.30e-3)	1.6892e-2 (3.40e-3)	1.7283e-2 (3.28e-3)	1.7502e-2 (3.10e-3)
DASCMP04	2	30	1.2373e-3 (9.53e-5)	1.5347e-3 (9.97e-4)	1.2349e-3 (1.34e-4)	1.2395e-3 (8.07e-5)	1.2958e-3 (2.44e-4)	1.6894e-3 (3.00e-3)	1.3255e-3 (3.14e-4)	1.3896e-3 (5.68e-4)	1.4172e-3 (7.51e-4)	1.2383e-3 (1.41e-4)
DASCMP05	2	30	2.9010e-3 (8.03e-5)	2.9196e-3 (1.39e-4)	2.9746e-3 (1.49e-4)	2.9492e-3 (1.53e-4)	2.9519e-3 (1.55e-4)	3.0081e-3 (1.64e-4)	2.9287e-3 (1.28e-4)	2.9297e-3 (1.01e-4)	2.9385e-3 (1.17e-4)	2.9153e-3 (1.28e-4)
DASCMP06	2	30	1.8165e-2 (2.84e-3)	1.9373e-2 (1.27e-3)	1.8177e-2 (2.84e-3)	1.7944e-2 (2.92e-3)	1.9122e-2 (1.75e-3)	1.8287e-2 (2.71e-3)	1.8262e-2 (2.80e-3)	1.8316e-2 (2.74e-3)	1.8006e-2 (2.95e-3)	1.7607e-2 (3.28e-3)
DASCMP07	3	30	3.0515e-2 (6.52e-4)	3.0356e-2 (9.47e-4)	3.0349e-2 (6.73e-4)	3.0576e-2 (8.90e-4)	3.0772e-2 (6.68e-4)	3.0398e-2 (7.99e-4)	3.0382e-2 (5.94e-4)	3.0551e-2 (6.96e-4)	3.0332e-2 (4.68e-4)	3.0763e-2 (6.45e-4)
DASCMP08	3	30	3.9096e-2 (8.43e-4)	3.9375e-2 (9.38e-4)	3.9493e-2 (8.07e-4)	3.9353e-2 (7.21e-4)	3.9408e-2 (1.17e-3)	3.9742e-2 (8.91e-4)	3.9381e-2 (8.96e-4)	3.9378e-2 (1.07e-3)	3.9442e-2 (1.04e-3)	3.9395e-2 (8.97e-4)
DASCMP09	3	30	3.9377e-2 (8.46e-4)	3.8751e-2 (7.15e-4)	3.9256e-2 (7.06e-4)	3.9093e-2 (7.32e-4)	3.9214e-2 (6.52e-4)	3.9269e-2 (8.65e-4)	3.9096e-2 (6.22e-4)	3.9120e-2 (7.88e-4)	3.9180e-2 (6.69e-4)	3.9223e-2 (6.99e-4)
LIRCM01	2	30	1.0261e-2 (1.48e-3)	1.0478e-2 (2.01e-3)	9.9921e-3 (1.31e-3)	1.0106e-2 (1.51e-3)	9.7738e-3 (1.19e-3)	9.4274e-3 (1.06e-3)	1.0063e-2 (1.64e-3)	1.0263e-2 (1.53e-3)	9.8015e-3 (1.37e-3)	9.7158e-3 (1.26e-3)
LIRCM02	2	30	8.4553e-3 (8.55e-4)	8.5957e-3 (1.10e-3)	8.3463e-3 (1.19e-3)	8.3882e-3 (1.01e-3)	8.8598e-3 (1.13e-3)	8.4402e-3 (1.75e-4)	8.5161e-3 (8.38e-4)	8.3769e-3 (7.80e-4)	8.5115e-3 (8.28e-4)	8.3924e-3 (9.93e-4)
LIRCM03	2	30	6.1259e-3 (1.20e-3)	5.6901e-3 (8.83e-4)	5.7023e-3 (1.43e-3)	5.6834e-3 (16.16e-4)	6.0494e-3 (8.84e-4)	6.1280e-3 (1.07e-3)	5.8540e-3 (8.93e-4)	6.3833e-3 (1.84e-3)	6.9732e-3 (1.26e-3)	5.9438e-3 (1.30e-3)
LIRCM04	3	30	5.4741e-3 (1.17e-3)	5.9109e-3 (1.88e-3)	5.5792e-3 (1.86e-3)	5.7023e-3 (2.01e-3)	5.4847e-3 (9.70e-4)	5.7124e-3 (1.03e-3)	5.9103e-3 (9.30e-4)	5.5776e-3 (1.01e-3)	6.2355e-3 (1.09e-3)	5.7518e-3 (6.94e-4)
LIRCM05	2	30	6.7158e-3 (3.68e-4)	6.7692e-3 (3.10e-4)	6.7086e-3 (4.77e-4)	6.7121e-3 (3.58e-4)	6.6637e-3 (3.93e-4)	6.6488e-3 (2.80e-4)	6.7292e-3 (3.44e-4)	6.7216e-3 (2.96e-4)	6.7476e-3 (3.74e-4)	6.7057e-3 (3.74e-4)
LIRCM06	2	30	6.4035e-3 (3.65e-4)	6.2982e-3 (3.02e-4)	4.9193e-3 (3.37e-4)	6.4397e-3 (4.35e-4)	6.6430e-3 (3.81e-4)	6.4785e-3 (4.08e-4)	6.5318e-3 (4.84e-4)	6.4433e-3 (4.69e-4)	6.4108e-3 (3.17e-4)	6.4363e-3 (2.87e-4)
LIRCM07	2	30	7.2565e-3 (3.21e-4)	7.2035e-3 (3.22e-4)	7.2054e-3 (3.26e-4)	7.1522e-3 (3.63e-4)	7.1971e-3 (2.82e-4)	7.1296e-3 (2.77e-4)	7.1829e-3 (2.62e-4)	7.3083e-3 (3.07e-4)	7.2550e-3 (3.49e-4)	7.1448e-3 (3.13e-4)
LIRCM08	2	30	7.0965e-3 (2.59e-4)	7.0729e-3 (3.10e-4)	7.0783e-3 (3.21e-4)	7.1635e-3 (3.18e-4)	7.2379e-3 (3.16e-4)	7.1800e-3 (3.28e-4)	7.1724e-3 (3.49e-4)	7.2974e-3 (4.09e-4)	7.1144e-3 (2.03e-4)	7.1944e-3 (3.72e-4)
LIRCM09	2	30	7.1277e-2 (2.11e-2)	6.8396e-2 (2.47e-2)	5.3215e-2 (3.32e-2)	5.3134e-2 (3.29e-2)	5.3550e-2 (3.29e-2)	6.2566e-2 (2.87e-2)	4.1785e-2 (3.39e-2)	5.7344e-2 (3.21e-2)	5.6401e-2 (3.20e-2)	5.4942e-2 (3.28e-2)
LIRCM10P	2	30	5.9817e-3 (2.65e-4)	6.1262e-3 (3.66e-4)	6.1942e-3 (3.09e-4)	6.1232e-3 (2.62e-4)	6.1070e-3 (3.09e-4)	5.9159e-3 (2.51e-4)	5.9640e-3 (3.56e-4)	5.9998e-3 (2.32e-4)	6.1009e-3 (3.11e-4)	6.1040e-3 (2.95e-4)
LIRCM01P	2	30	2.5610e-3 (2.25e-4)	2.5899e-3 (2.14e-4)	2.5037e-3 (1.14e-4)	2.5627e-3 (1.63e-4)	2.5544e-3 (1.56e-4)	2.5924e-3 (3.37e-4)	2.5598e-3 (1.89e-4)	2.5872e-3 (3.57e-4)	2.4847e-3 (8.65e-5)	2.6084e-3 (1.98e-4)
LIRCM02P	2	30	3.9752e-3 (1.63e-3)	3.6423e-3 (4.73e-4)	3.5735e-3 (2.52e-4)	3.9360e-3 (8.24e-4)	3.6814e-3 (5.64e-4)	3.5874e-3 (4.21e-4)	3.7524e-3 (6.39e-4)	3.7453e-3 (6.73e-4)	3.6768e-3 (5.39e-4)	3.6565e-3 (3.95e-4)
LIRCM03P	3	30	4.2489e-1 (5.44e-1)	2.6224e-1 (4.19e-1)	3.4348e-1 (4.92e-1)	2.5743e-1 (3.94e-1)	1.0102e-1 (1.45e-3)	1.0097e-1 (1.36e-3)	1.0061e-1 (1.04e-3)	1.0055e-1 (1.53e-3)	1.0113e-1 (1.47e-3)	1.0201e-1 (1.50e-3)
LIRCM04P	3	30	1.7199e-1 (2.72e-1)	9.7915e-2 (1.09e-3)	9.7779e-2 (8.60e-4)	9.7868e-2 (8.23e-4)	9.7726e-2 (9.30e-4)	9.7935e-2 (8.02e-4)	9.7855e-2 (1.07e-3)	9.7646e-2 (8.56e-4)	9.7844e-2 (8.20e-4)	9.7862e-2 (8.05e-4)

TABLE SIX
THE AVERAGE HV RESULTS OBTAINED BY ACEMT WITH DIFFERENT Δ ON THREE TEST BENCHMARK SUITES.

THE AVERAGE IGD+ RESULTS OBTAINED BY ACEMT WITH DIFFERENT Δ ON THREE TEST BENCHMARK SUITES.

CF1	2	10	1.1883e-3 (1.93e-4)	1.1805e-3 (1.72e-4)	1.1824e-3 (1.75e-4)	1.1118e-3 (1.58e-4)	1.1038e-3 (1.90e-4)	1.1190e-3 (1.68e-4)	1.1080e-3 (1.86e-4)	1.1579e-3 (1.69e-4)	1.1090e-3 (1.93e-4)	1.1828e-3 (1.81e-4)
CF2	2	10	2.2530e-3 (1.01e-4)	2.2376e-3 (9.40e-5)	2.2161e-3 (1.01e-4)	2.2388e-3 (9.68e-5)	2.2359e-3 (8.60e-5)	2.2369e-3 (9.17e-5)	2.2320e-3 (8.90e-5)	2.2272e-3 (8.31e-5)	2.2471e-3 (1.06e-4)	2.2343e-3 (6.82e-5)
CF3	2	10	1.5624e-2 (6.62e-2)	1.5555e-2 (6.67e-2)	1.6924e-2 (5.55e-2)	1.6455e-2 (6.24e-2)	1.8797e-2 (1.59e-2)	1.6141e-2 (8.28e-2)	1.6470e-2 (6.51e-2)	1.5830e-2 (7.55e-2)	1.7356e-2 (6.16e-2)	1.5164e-2 (5.33e-2)
CF4	2	10	1.4803e-2 (5.71e-2)	1.6102e-2 (5.35e-2)	1.3759e-2 (3.89e-3)	1.4998e-2 (5.73e-3)	1.5818e-2 (5.71e-3)	1.3778e-2 (9.39e-3)	1.6774e-2 (6.76e-3)	1.5301e-2 (4.31e-3)	1.5154e-2 (4.85e-3)	1.5164e-2 (4.85e-3)
CF5	2	10	9.7691e-3 (4.66e-2)	9.9404e-2 (5.87e-2)	1.0404e-2 (4.66e-2)	9.3653e-2 (6.92e-2)	9.8692e-2 (6.83e-2)	1.0380e-2 (6.20e-2)	1.0258e-2 (6.76e-2)	9.5936e-2 (6.68e-2)	9.5936e-2 (6.68e-2)	9.0058e-2 (1.50e-2)
CF6	2	10	9.7691e-3 (4.66e-2)	9.9404e-2 (5.87e-2)	1.0404e-2 (4.66e-2)	9.3653e-2 (6.92e-2)	9.8692e-2 (6.83e-2)	1.0380e-2 (6.20e-2)	1.0258e-2 (6.76e-2)	9.5936e-2 (6.68e-2)	9.5936e-2 (6.68e-2)	9.0058e-2 (1.50e-2)
CF7	2	10	6.9199e-2 (5.63e-2)	6.8823e-2 (5.65e-2)	7.1515e-2 (5.20e-2)	7.0391e-2 (5.85e-2)	7.1515e-2 (5.20e-2)	1.0454e-2 (1.61e-2)	6.7800e-3 (2.80e-3)	6.9786e-3 (4.99e-3)	6.7708e-3 (4.24e-2)	7.4900e-3 (3.96e-2)
CF8	3	10	1.1731e-1 (3.04e-3)	1.1043e-1 (2.22e-3)	1.0752e-1 (1.29e-2)	1.0614e-1 (1.90e-2)	1.0306e-1 (1.29e-2)	1.0324e-1 (1.44e-2)	1.0513e-1 (1.55e-2)	9.9702e-2 (3.66e-2)	1.0366e-1 (2.46e-2)	1.0576e-1 (2.43e-2)
CF9	3	10	4.5202e-2 (6.35e-3)	4.2781e-2 (5.09e-3)	4.4868e-2 (7.49e-3)	4.6932e-2 (7.15e-3)	4.3576e-2 (6.43e-3)	4.4303e-2 (8.21e-3)	4.4344e-2 (9.45e-3)	4.2450e-2 (4.77e-3)	4.3984e-2 (6.88e-3)	4.1876e-2 (4.37e-3)
CF10	3	10	1.5153e-1 (7.99e-2)	1.6981e-2 (9.40e-2)	1.5151e-1 (6.86e-2)	1.4472e-1 (6.76e-2)	1.6933e-1 (7.98e-2)	1.5593e-1 (9.25e-2)	1.5395e-1 (9.13e-2)	1.7177e-1 (9.48e-2)	1.4883e-1 (9.79e-2)	1.5733e-1 (9.69e-2)
DASCMOP1	2	30	1.4874e-3 (4.31e-5)	1.4958e-3 (5.16e-5)	1.5135e-3 (3.40e-5)	1.4873e-3 (5.50e-5)	1.5035e-3 (6.59e-5)	1.5105e-3 (5.84e-5)	1.5066e-3 (6.63e-5)	1.5100e-3 (6.88e-5)	1.5106e-3 (6.42e-5)	1.5163e-3 (5.87e-5)
DASCMOP2	2	30	2.3699e-3 (5.55e-5)	2.7085e-3 (7.77e-5)	2.7336e-3 (7.94e-5)	2.7100e-3 (7.52e-5)	2.7217e-3 (7.80e-5)	2.7240e-3 (8.15e-5)	2.7175e-3 (6.48e-5)	2.7262e-3 (1.05e-5)	2.7243e-3 (6.57e-5)	2.7370e-3 (8.40e-5)
DASCMOP3	2	30	3.2965e-3 (1.08e-4)	5.2703e-3 (9.71e-5)	5.2468e-3 (8.26e-5)	5.2808e-3 (1.23e-4)	5.2990e-3 (1.42e-4)	5.2940e-3 (1.26e-4)	5.3199e-3 (1.42e-4)	5.3190e-3 (1.34e-4)	5.0893e-4 (3.14e-4)	5.2978e-3 (1.19e-4)
DASCMOP4	2	30	6.9231e-4 (4.24e-5)	6.8337e-4 (5.34e-5)	6.9454e-4 (4.57e-5)	6.9859e-4 (4.94e-5)	7.0080e-4 (6.31e-5)	2.2230e-4 (5.96e-5)	7.0748e-4 (5.55e-5)	7.0852e-4 (5.38e-5)	8.0895e-4 (4.40e-4)	6.9474e-4 (4.36e-5)
DASCMOP5	2	30	1.9573e-3 (7.16e-4)	1.9696e-3 (7.04e-4)	2.0353e-3 (3.11e-4)	2.0154e-3 (3.16e-4)	2.0173e-3 (3.14e-4)	2.0454e-3 (3.140e-4)	1.9905e-3 (1.22e-4)	1.9941e-3 (1.05e-4)	2.0185e-3 (3.12e-4)	1.9953e-3 (3.12e-4)
DASCMOP6	2	30	3.2028e-3 (6.85e-5)	5.3170e-3 (1.06e-4)	5.2728e-3 (6.86e-5)	5.2676e-3 (7.73e-5)	5.3085e-3 (1.12e-4)	5.3720e-3 (3.45e-5)	5.3133e-3 (1.06e-4)	5.3974e-3 (2.19e-4)	5.3584e-3 (1.68e-4)	5.3133e-3 (1.06e-4)
DASCMOP7	2	30	3.2028e-2 (6.79e-4)	2.3094e-2 (9.16e-4)	2.3245e-2 (7.04e-4)	2.3346e-2 (8.34e-4)	2.3495e-2 (7.03e-4)	2.3211e-2 (7.52e-4)	2.3238e-2 (6.66e-4)	2.3440e-2 (6.81e-4)	2.3566e-2 (6.90e-4)	2.3234e-2 (6.08e-4)
DASCMOP8	3	30	1.7301e-2 (5.88e-4)	1.6767e-2 (7.31e-4)	1.7668e-2 (6.09e-4)	1.7614e-2 (6.59e-4)	1.7880e-2 (1.920e-4)	1.7672e-2 (7.15e-4)	1.7788e-2 (7.74e-4)	1.7948e-2 (9.63e-4)	1.7614e-2 (6.19e-4)	1.7790e-2 (8.33e-4)
DASCMOP9	3	30	1.6993e-2 (5.46e-4)	1.6744e-2 (4.54e-4)	1.6997e-2 (5.25e-4)	1.7043e-2 (6.87e-4)	1.6861e-2 (5.20e-4)	1.6956e-2 (6.36e-4)	1.6785e-2 (4.91e-4)	1.7124e-2 (6.92e-4)	1.6904e-2 (6.02e-4)	1.6892e-2 (4.39e-4)
LIRCMOP1	2	30	6.3672e-3 (6.98e-4)	6.4386e-3 (9.37e-4)	6.2749e-3 (6.44e-4)	6.4121e-3 (7.80e-4)	6.2620e-3 (4.78e-4)	6.0597e-3 (5.88e-4)	6.4447e-3 (6.92e-4)	6.4380e-3 (6.62e-4)	6.3734e-3 (7.40e-4)	6.2269e-3 (6.41e-4)
LIRCMOP2	2	30	4.6394e-3 (5.37e-4)	6.5673e-3 (7.21e-4)	6.3794e-3 (8.07e-4)	6.3757e-3 (6.55e-4)	6.7378e-3 (8.92e-4)	6.4322e-3 (4.85e-4)	6.3600e-3 (5.59e-4)	6.4249e-3 (5.01e-4)	6.5333e-3 (5.77e-4)	6.3501e-3 (6.43e-4)
LIRCMOP3	2	30	3.8384e-3 (4.69e-4)	3.6529e-3 (5.61e-4)	3.5673e-3 (6.05e-4)	3.6860e-3 (5.69e-4)	3.8615e-3 (5.10e-4)	3.9971e-3 (7.98e-4)	3.8040e-3 (6.20e-4)	3.8957e-3 (6.22e-4)	3.8137e-3 (8.54e-4)	3.9755e-3 (7.09e-4)
LIRCMOP4	2	30	3.4911e-3 (8.22e-4)	4.6726e-3 (1.23e-3)	4.3904e-3 (7.72e-4)	4.5933e-3 (1.48e-3)	4.5144e-3 (7.35e-4)	4.4848e-3 (7.35e-4)	4.6827e-3 (6.99e-4)	4.6827e-3 (8.06e-4)	5.0877e-3 (9.28e-4)	4.6394e-3 (5.33e-4)
LIRCMOP5	2	30	6.3628e-3 (3.88e-4)	6.4246e-3 (3.36e-4)	6.3607e-3 (5.10e-4)	6.3616e-3 (3.71e-4)	6.3173e-3 (4.25e-4)	3.3029e-3 (6.12e-4)	6.3859e-3 (3.55e-4)	6.3705e-3 (3.28e-4)	6.3953e-3 (3.02e-4)	6.3599e-3 (3.95e-4)
LIRCMOP6	2	30	5.7697e-3 (3.78e-4)	5.6785e-3 (3.14e-4)	5.8555e-3 (4.52e-4)	5.7996e-3 (4.46e-4)	5.8330e-3 (4.10e-4)	5.8333e-3 (4.31e-4)	5.8898e-3 (4.57e-4)	5.8153e-3 (5.03e-4)	5.7805e-3 (3.33e-4)	5.8301e-3 (2.97e-4)
LIRCMOP7	2	30	5.4430e-3 (3.06e-4)	5.3794e-3 (2.96e-4)	5.5372e-3 (2.84e-4)	5.3467e-3 (3.22e-4)	5.3853e-3 (2.58e-4)	5.2884e-3 (4.24e-4)	5.3271e-3 (3.20e-4)	5.4996e-3 (3.62e-4)	5.3669e-3 (3.36e-4)	5.3119e-3 (3.14e-4)
LIRCMOP8	2	30	5.2804e-3 (2.75e-4)	5.2670e-3 (3.31e-4)	5.5353e-3 (3.37e-4)	5.3327e-3 (3.32e-4)	5.3840e-3 (2.88e-4)	5.3206e-3 (3.24e-4)	5.3939e-3 (3.29e-4)	5.3877e-3 (2.92e-4)	5.0877e-3 (2.98e-4)	5.4639e-3 (3.53e-4)
LIRCMOP9	2	30	4.7852e-2 (1.35e-2)	4.5972e-2 (1.60e-2)	4.3682e-2 (1.21e-2)	4.6117e-2 (2.13e-2)	4.6610e-2 (2.14e-2)	4.2414e-2 (1.86e-2)	2.8942e-2 (2.22e-2)	3.9017e-2 (2.09e-2)	3.8579e-2 (2.12e-2)	3.7105e-2 (2.04e-2)
LIRCMOP10	2	30	5.0092e-2 (2.25e-2)	5.7770e-2 (2.31e-2)	5.9642e-2 (2.31e-2)	5.7770e-2 (2.31e-2)	5.8566e-2 (2.35e-2)	5.6220e-2 (2.34e-2)	5.8630e-2 (2.34e-2)	5.8630e-2 (2.34e-2)	5.8630e-2 (2.34e-2)	5.8630e-2 (2.34e-2)
LIRCMOP11	2	30	3.2660e-2 (2.25e-2)	3.7770e-2 (1.14e-2)	3.6770e-2 (1.14e-2)	3.2755e-2 (1.63e-2)	3.6566e-2 (1.53e-2)	3.6566e-2 (1.51e-2)	3.7712e-2 (1.53e-2)	3.6566e-2 (1.53e-2)	3.6566e-2 (1.53e-2)	3.6566e-2 (1.53e-2)
LIRCMOP12	2	30	3.4984e-3 (1.61e-3)	4.9848e-4 (4.44e-4)	1.0288e-3 (3.64e-4)	1.2403e-3 (8.27e-4)	1.0018e-3 (5.54e-4)	6.8332e-3 (4.00e-4)	4.0494e-3 (5.52e-4)	1.0195e-2 (8.09e-3)	6.6072e-4 (6.64e-4)	4.7496e-4 (2.02e-4)
LIRCMOP13	3	30	3.9507e-1 (5.61e-1)	2.2681e-1 (4.12e-1)	3.1097e-1 (5.08e-1)	2.2176e-1 (4.05e-1)	6.0091e-2 (2.19e-3)	5.9687e-2 (1.62e-3)	5.9703e-2 (1.62e-3)	6.0212e-2 (2.17e-3)	6.0419e-2 (1.89e-3)	6.0047e-2 (2.26e-3)
LIRCMOP14	3	30	1.2300e-1 (2.71e-1)	4.9208e-2 (1.34e-3)	4.9656e-2 (1.42e-3)	4.9380e-2 (1.30e-3)	4.9116e-2 (1.36e-3)	4.9582e-2 (1.36e-3)	4.9707e-2 (1.30e-3)	4.9022e-2 (1.31e-3)	4.9447e-2 (1.28e-3)	4.9518e-2 (1.24e-3)

TABLE SXI
THE AVERAGE IGD RESULTS OBTAINED BY ACEMT WITH DIFFERENT k ON THREE TEST BENCHMARK SUITES.

Problem	M	D	$k = 0.1 * l$	$k = 0.3 * l$	$k = 0.5 * l$	$k = 0.9 * l$	$k = \sqrt{l}$	$k = 0.7 * l$ (ACEMT)	
CF1	2	10	1.1702e-3 (1.74e-4) =	1.1279e-3 (1.53e-4) =	1.1038e-3 (1.90e-4) =	1.1170e-3 (1.98e-4) =	1.1961e-3 (1.88e-4) =	1.1402e-3 (2.01e-4)	
CF2	2	10	2.6914e-3 (8.92e-5) =	2.7056e-3 (7.15e-5) =	2.6876e-3 (7.56e-5) =	2.6768e-3 (7.21e-5) =	2.7136e-3 (8.41e-5) =	2.6747e-3 (8.88e-5)	
CF3	2	10	2.0798e-1 (9.42e-2) =	2.0014e-1 (7.93e-2) =	2.3492e-1 (9.75e-2) =	2.0367e-1 (8.37e-2) =	1.7330e-1 (7.01e-2) =	1.9825e-1 (7.46e-2)	
CF4	2	10	1.8194e-2 (5.49e-3) =	1.6549e-2 (5.46e-3) =	1.8268e-2 (6.81e-3) =	1.8249e-2 (5.97e-3) =	1.9950e-2 (7.48e-3) =	1.7681e-2 (5.43e-3)	
CF5	2	10	1.3103e-1 (8.44e-2) =	1.1839e-1 (7.12e-2) =	1.1655e-1 (8.98e-2) =	1.1130e-1 (6.23e-2) =	1.1582e-1 (5.03e-2) =	1.0703e-1 (6.70e-2)	
CF6	2	10	1.4233e-2 (2.50e-3) =	1.2683e-2 (2.72e-3) =	1.3525e-2 (2.58e-3) =	1.5123e-2 (3.38e-3) =	1.5005e-2 (3.42e-3) =	1.3672e-2 (2.32e-3)	
CF7	2	10	8.0324e-2 (4.75e-2) =	1.2828e-1 (8.70e-2) =	1.1193e-1 (8.95e-2) =	1.3998e-1 (1.13e-1) =	9.0063e-2 (6.78e-2) =	1.1045e-1 (6.91e-2)	
CF8	3	10	1.4456e-1 (3.14e-2) =	1.5170e-1 (3.99e-2) =	1.4326e-1 (2.08e-2) =	1.4342e-1 (2.23e-2) =	1.4468e-1 (3.35e-2) =	1.5007e-1 (3.19e-2)	
CF9	3	10	7.1303e-2 (7.34e-3) =	7.0539e-2 (6.15e-3) =	7.3114e-2 (9.69e-3) =	7.3399e-2 (6.41e-3) =	7.3531e-2 (9.53e-3) =	7.2475e-2 (8.57e-3)	
CF10	3	10	2.2391e-1 (9.90e-2) =	2.1057e-1 (9.38e-2) =	2.2933e-1 (1.00e-1) =	2.1893e-1 (9.08e-2) =	2.1027e-1 (1.00e-1) =	1.8796e-1 (8.24e-2)	
DASCMOP1	2	30	3.1262e-3 (2.65e-4) =	3.0104e-3 (2.04e-4) =	3.0116e-3 (2.33e-4) =	2.9465e-3 (3.46e-4) =	3.0151e-3 (2.71e-4) =	2.9544e-3 (2.59e-4)	
DASCMOP2	2	30	3.9980e-3 (7.10e-5) =	3.9567e-3 (7.43e-5) =	3.9536e-3 (6.47e-5) =	3.9325e-3 (5.06e-5) =	3.9581e-3 (5.61e-5) =	3.9497e-3 (6.60e-5)	
DASCMOP3	2	30	1.7813e-2 (3.11e-3) =	1.6586e-2 (3.50e-3) =	1.7460e-2 (3.25e-3) =	1.7653e-2 (3.09e-3) =	1.7061e-2 (3.34e-3) =	1.7945e-2 (2.98e-3)	
DASCMOP4	2	30	1.8056e-3 (1.12e-3) =	1.3388e-3 (5.58e-4) +	1.2958e-3 (2.44e-4) =	1.1994e-3 (5.46e-5) =	1.3360e-3 (5.20e-4) =	1.4857e-3 (8.82e-4)	
DASCMOP5	2	30	3.0247e-3 (1.51e-4) =	2.9678e-3 (1.26e-4) =	2.9519e-3 (1.55e-4) =	2.8946e-3 (1.38e-4) =	2.9743e-3 (1.48e-4) =	2.9397e-3 (1.54e-4)	
DASCMOP6	2	30	1.9008e-2 (2.14e-3) =	1.8268e-2 (2.82e-3) =	1.9122e-2 (1.75e-3) =	1.8718e-2 (2.34e-3) =	1.8577e-2 (2.65e-3) =	1.8463e-2 (2.65e-3)	
DASCMOP7	3	30	3.0754e-2 (7.05e-4) =	3.0555e-2 (6.67e-4) =	3.0727e-2 (6.68e-4) =	3.0471e-2 (7.80e-4) =	3.0399e-2 (9.45e-4) =	3.0501e-2 (7.26e-4)	
DASCMOP8	3	30	3.9664e-2 (8.73e-4) =	3.9223e-2 (7.76e-4) =	3.9408e-2 (1.17e-3) =	4.0142e-2 (9.89e-4) -	3.9336e-2 (9.53e-4) =	3.9588e-2 (7.56e-4)	
DASCMOP9	3	30	3.9108e-2 (9.66e-4) =	3.8812e-2 (7.85e-4) +	3.9214e-2 (6.52e-4) =	3.9643e-2 (7.20e-4) =	3.9166e-2 (7.73e-4) =	3.9317e-2 (6.21e-4)	
LIRCMOP1	2	30	1.5765e-2 (3.70e-3) -	1.5428e-2 (3.29e-3) -	9.7738e-3 (1.19e-3) =	9.9971e-3 (1.69e-3) =	9.9813e-3 (1.34e-3) =	9.9389e-3 (1.27e-3)	
LIRCMOP2	2	30	1.1638e-2 (1.25e-3) -	1.1201e-2 (1.97e-3) -	8.8598e-3 (1.33e-3) =	8.4610e-3 (1.02e-3) =	8.5017e-3 (1.03e-3) =	8.7417e-3 (1.03e-3)	
LIRCMOP3	2	30	9.4362e-3 (4.91e-3) -	8.7367e-3 (3.03e-3) -	6.0494e-3 (8.84e-4) -	6.2353e-3 (2.53e-3) =	5.9541e-3 (7.15e-4) -	5.4555e-3 (8.91e-4)	
LIRCMOP4	2	30	7.7759e-3 (1.66e-3) -	8.0352e-3 (2.49e-3) -	5.4847e-3 (9.70e-4) =	5.4393e-3 (9.36e-4) =	5.6790e-3 (1.16e-3) =	5.7106e-3 (2.20e-3)	
LIRCMOP5	2	30	6.6600e-3 (3.67e-4) =	6.5588e-3 (3.44e-4) =	6.6637e-3 (3.93e-4) =	6.8073e-3 (4.19e-4) =	6.5737e-3 (3.28e-4) =	6.6299e-3 (3.62e-4)	
LIRCMOP6	2	30	6.2929e-3 (3.67e-4) =	6.4003e-3 (4.04e-4) =	6.4630e-3 (3.81e-4) =	6.2717e-3 (2.70e-4) =	6.3834e-3 (3.66e-4) =	6.3428e-3 (3.51e-4)	
LIRCMOP7	2	30	7.1548e-3 (2.35e-4) =	7.1388e-3 (2.86e-4) =	7.1971e-3 (2.82e-4) =	7.0267e-3 (2.48e-4) =	7.2180e-3 (3.24e-4) =	7.0864e-3 (2.62e-4)	
LIRCMOP8	2	30	7.2816e-3 (3.94e-4) -	7.2742e-3 (3.09e-4) -	7.2397e-3 (3.16e-4) -	7.0263e-3 (2.01e-4) =	7.1347e-3 (3.57e-4) =	6.9348e-3 (2.46e-4)	
LIRCMOP9	2	30	1.5363e-2 (1.27e-2) +	3.3594e-2 (3.11e-2) =	5.3550e-2 (3.29e-2) =	6.2149e-2 (2.94e-2) =	6.4179e-2 (2.83e-2) =	4.8928e-2 (3.33e-2)	
LIRCMOP10	2	30	6.7676e-3 (4.44e-4) =	6.8683e-3 (3.82e-4) =	6.1070e-3 (3.09e-4) =	6.0713e-3 (2.86e-4) =	6.1088e-3 (2.90e-4) =	6.0298e-3 (2.94e-4)	
LIRCMOP11	2	30	2.7064e-3 (1.60e-4) -	2.6644e-3 (1.13e-4) -	2.5544e-3 (1.56e-4) =	2.5240e-3 (1.12e-4) =	2.5836e-3 (1.37e-4) =	2.5479e-3 (1.55e-4)	
LIRCMOP12	2	30	3.9285e-3 (3.29e-4) -	3.8060e-3 (3.06e-4) -	3.6814e-3 (5.64e-4) =	3.5901e-3 (4.36e-4) =	3.5450e-3 (4.66e-4) =	3.7027e-3 (7.90e-4)	
LIRCMOP13	3	30	1.0088e-1 (1.35e-3) =	1.0132e-1 (1.33e-3) =	1.0102e-1 (1.45e-3) =	1.8203e-1 (3.07e-1) =	1.4173e-1 (2.21e-1) =	1.5208e-1 (2.26e-1)	
LIRCMOP14	3	30	9.7691e-2 (1.04e-3) =	9.8143e-2 (1.18e-3) =	9.7726e-2 (9.30e-4) =	1.6746e-1 (2.68e-1) =	9.7523e-2 (9.16e-4) =	2.3241e-1 (3.62e-1)	
$+/-=$		1/12/20		2/8/23		0/2/31		0/3/30	

TABLE SXII
THE AVERAGE HV RESULTS OBTAINED BY ACEMT WITH DIFFERENT k ON THREE TEST BENCHMARK SUITES.

Problem	M	D	$k = 0.1 * l$	$k = 0.3 * l$	$k = 0.5 * l$	$k = 0.9 * l$	$k = \sqrt{l}$	$k = 0.7 * l$ (ACEMT)
CF1	2	10	7.7468e-1 (2.13e-4) =	7.7474e-1 (1.86e-4) =	7.7476e-1 (2.31e-4) =	7.7475e-1 (2.40e-4) =	7.7465e-1 (2.30e-4) =	7.7472e-1 (2.46e-4)
CF2	2	10	8.8854e-1 (2.36e-4) =	8.8852e-1 (2.28e-4) =	8.8851e-1 (3.40e-4) =	8.8856e-1 (3.09e-4) =	8.8838e-1 (2.93e-4) =	8.8854e-1 (2.71e-4)
CF3	2	10	4.1465e-1 (5.64e-5) =	4.1289e-1 (5.63e-2) =	4.0291e-1 (5.15e-2) =	4.0599e-1 (4.90e-2) =	4.2921e-1 (6.28e-2) =	4.1597e-1 (5.20e-2)
CF4	2	10	7.1270e-1 (7.35e-3) =	7.1456e-1 (7.67e-3) =	7.1260e-1 (9.10e-3) =	7.1257e-1 (7.93e-3) =	7.1051e-1 (9.80e-3) =	7.1313e-1 (7.61e-3)
CF5	2	10	5.6969e-1 (8.95e-2) =	5.8504e-1 (6.51e-2) =	5.8856e-1 (8.00e-2) =	5.8301e-1 (5.96e-2) =	5.7739e-1 (5.50e-2) =	5.9568e-1 (7.23e-2)
CF6	2	10	8.9957e-1 (3.76e-3) =	8.9993e-1 (3.53e-3) =	8.9935e-1 (3.93e-3) =	8.9730e-1 (5.08e-3) =	8.9866e-1 (4.47e-3) =	8.9901e-1 (4.56e-3)
CF7	2	10	7.9320e-1 (6.54e-2) =	7.2875e-1 (1.16e-1) =	7.5366e-1 (1.10e-1) =	7.1658e-1 (1.44e-1) =	7.7840e-1 (1.80e-2) =	7.5029e-1 (9.36e-2)
CF8	3	10	7.0218e-1 (5.09e-2) =	6.9204e-1 (6.53e-2) =	7.0617e-1 (3.47e-2) =	7.0277e-1 (3.95e-2) =	6.9788e-1 (5.51e-2) =	6.9274e-1 (5.65e-2)
CF9	3	10	8.2646e-1 (1.80e-2) =	8.3146e-1 (1.24e-2) +	8.2646e-1 (1.90e-2) =	8.2371e-1 (1.68e-2) =	8.2246e-1 (2.01e-2) =	8.2402e-1 (1.56e-2)
CF10	3	10	5.4543e-1 (1.46e-1) =	5.6734e-1 (1.45e-1) =	5.3742e-1 (1.51e-1) =	5.5064e-1 (1.39e-1) =	5.6069e-1 (1.59e-1) =	5.8976e-1 (1.33e-1)
DASCMOP1	2	30	3.6161e-1 (5.00e-4) =	3.6179e-1 (4.94e-4) =	3.6184e-1 (4.82e-4) =	3.6171e-1 (4.81e-4) =	3.6171e-1 (5.03e-4) =	3.6176e-1 (5.30e-4)
DASCMOP2	2	30	5.0497e-1 (4.82e-5) =	5.0501e-1 (5.81e-5) =	5.0501e-1 (5.55e-5) =	5.0505e-1 (4.03e-5) =	5.0501e-1 (4.74e-5) =	5.0505e-1 (4.96e-5)
DASCMOP3	2	30	4.5524e-1 (1.62e-4) =	4.5528e-1 (1.88e-4) =	4.5533e-1 (1.50e-4) =	4.5539e-1 (1.23e-4) =	4.5533e-1 (1.46e-4) =	4.5539e-1 (1.09e-4)
DASCMOP4	2	30	3.4609e-1 (2.82e-3) =	3.4694e-1 (1.56e-3) =	3.4721e-1 (3.73e-4) =	3.4741e-1 (3.16e-4) +	3.4689e-1 (1.51e-3) =	3.4646e-1 (2.51e-3)
DASCMOP5	2	30	4.9885e-1 (1.73e-4) =	4.9892e-1 (1.92e-4) =	4.9903e-1 (1.77e-4) =	4.9906e-1 (2.12e-4) =	4.9895e-1 (2.10e-4) =	4.9896e-1 (2.96e-4)
DASCMOP6	2	30	4.5533e-1 (1.12e-4) =	4.5533e-1 (1.59e-4) =	4.5538e-1 (1.50e-4) =	4.5536e-1 (1.63e-4) =	4.5530e-1 (1.48e-4) =	4.5537e-1 (1.23e-4)
DASCMOP7	3	30	4.5314e-1 (7.08e-4) =	4.5380e-1 (4.12e-4) =	4.5397e-1 (4.94e-4) =	4.5437e-1 (4.25e-4) =	4.5393e-1 (4.63e-4) =	4.5428e-1 (3.21e-4)
DASCMOP8	3	30	3.7357e-1 (3.66e-4) =	3.7397e-1 (3.03e-4) =	3.7421e-1 (4.54e-4) =	3.7435e-1 (4.16e-4) =	3.7398e-1 (4.20e-4) =	3.7425e-1 (3.83e-4)
DASCMOP9	3	30	3.7441e-1 (3.56e-4) =	3.7464e-1 (3.64e-4) =	3.7472e-1 (2.66e-4) =	3.7483e-1 (2.95e-4) +	3.7445e-1 (3.42e-4) =	3.7466e-1 (3.30e-4)
LIRCMOP1	2	30	3.8270e-1 (1.78e-3) -	3.8311e-1 (1.16e-3) -	3.8368e-1 (4.32e-4) =	3.8564e-1 (5.45e-4) =	3.8559e-1 (5.04e-4) =	3.8567e-1 (4.99e-4)
LIRCMOP2	2	30	5.0587e-1 (1.39e-3) -	5.0620e-1 (1.20e-3) -	5.0782e-1 (5.48e-4) =	5.0794e-1 (5.39e-4) =	5.0782e-1 (6.17e-4) =	5.0782e-1 (5.21e-4)
LIRCMOP3	2	30	3.4570e-1 (1.48e-3) -	3.4593e-1 (9.95e-4) -	3.4709e-1 (6.60e-4) -	3.4740e-1 (7.99e-4) =	3.4721e-1 (5.26e-4) =	3.4751e-1 (5.70e-4)
LIRCMOP4	2	30	4.5684e-1 (1.29e-3) -	4.5702e-1 (1.31e-3) -	4.5872e-1 (6.79e-4) =	4.5864e-1 (8.27e-4) =	4.5840e-1 (7.31e-4) =	4.5861e-1 (1.07e-3)
LIRCMOP5	2	30	4.2607e-1 (1.66e-4) =	4.2612e-1 (1.62e-4) =	4.2604e-1 (1.94e-4) =	4.2595e-1 (2.35e-4) =	4.2608e-1 (1.72e-4) =	4.2605e-1 (1.65e-4)
LIRCMOP6	2	30	3.3141e-1 (1.84e-4) =	3.3135e-1 (1.99e-4) =	3.3131e-1 (2.09e-4) =	3.3141e-1 (1.22e-4) =	3.3137e-1 (1.82e-4) =	3.3139e-1 (1.80e-4)
LIRCMOP7	2	30	4.5109e-1 (1.11e-4) =	4.5107e-1 (1.21e-4) =	4.5106e-1 (1.26e-4) =	4.5117e-1 (1.23		

TABLE SXIII

THE AVERAGE IGD+ RESULTS OBTAINED BY ACEMT WITH DIFFERENT k ON THREE TEST BENCHMARK SUITES.

Problem	M	D	$k = 0.1 * l$	$k = 0.3 * l$	$k = 0.5 * l$	$k = 0.9 * l$	$k = \sqrt{l}$	$k = 0.7 * l$ (ACEMT)
CF1	2	10	1.1702e-3 (1.74e-4) =	1.1279e-3 (1.53e-4) =	1.1038e-3 (1.90e-4) =	1.1170e-3 (1.98e-4) =	1.1961e-3 (1.88e-4) =	1.1402e-3 (2.01e-4)
CF2	2	10	2.2257e-3 (9.94e-5) =	2.2571e-3 (7.01e-5) =	2.2359e-3 (8.60e-5) =	2.2113e-3 (7.84e-5) =	2.2564e-3 (8.94e-5) =	2.2195e-3 (1.08e-4)
CF3	2	10	1.7508e-1 (5.89e-2) =	1.7272e-1 (5.91e-2) =	1.8470e-1 (5.39e-2) =	1.7561e-1 (5.73e-2) =	1.5341e-1 (6.12e-2) =	1.7331e-1 (6.29e-2)
CF4	2	10	1.5631e-2 (4.44e-3) =	1.4494e-2 (4.78e-3) =	1.5818e-2 (5.71e-3) =	1.5684e-2 (4.86e-3) =	1.7016e-2 (6.03e-3) =	1.5362e-2 (4.68e-3)
CF5	2	10	1.0933e-1 (7.41e-2) =	9.5904e-2 (5.39e-2) =	9.3655e-2 (6.92e-2) =	9.3308e-2 (4.58e-2) =	9.7275e-2 (4.31e-2) =	8.7367e-2 (5.71e-2) =
CF6	2	10	9.7999e-3 (1.16e-3) =	9.2789e-3 (1.57e-3) =	9.2838e-3 (1.22e-3) =	1.0247e-2 (1.73e-3) =	1.0449e-2 (1.94e-3) =	9.7175e-3 (1.31e-3)
CF7	2	10	6.7270e-2 (4.70e-2) =	1.0611e-1 (8.64e-2) =	9.3422e-2 (8.08e-2) =	1.1683e-1 (1.09e-1) =	7.3588e-2 (6.62e-2) =	8.7426e-2 (5.93e-2)
CF8	3	10	1.0597e-1 (1.86e-2) =	1.1068e-1 (3.09e-2) =	1.0306e-1 (1.29e-2) =	1.0638e-1 (1.81e-2) =	1.0680e-1 (1.98e-2) =	1.0849e-1 (2.04e-2)
CF9	3	10	4.2761e-2 (5.57e-3) =	4.2362e-2 (4.31e-3) =	4.3576e-2 (6.43e-3) =	4.4742e-2 (4.51e-3) =	4.4789e-2 (6.03e-3) =	4.3557e-2 (4.69e-3)
CF10	3	10	1.7367e-1 (9.30e-2) =	1.5969e-1 (8.55e-2) =	1.6933e-1 (7.98e-2) =	1.6775e-1 (7.65e-2) =	1.5330e-1 (7.99e-2) =	1.4466e-1 (7.34e-2) =
DASCMOP1	2	30	1.5762e-3 (7.26e-5) -	1.5371e-3 (8.06e-5) -	1.5035e-3 (6.59e-5) =	1.4561e-3 (4.82e-5) +	1.5321e-3 (6.72e-5) -	1.4894e-3 (6.30e-5)
DASCMOP2	2	30	2.7837e-3 (7.10e-5) -	2.7279e-3 (9.18e-5) =	2.7217e-3 (7.80e-5) =	2.6806e-3 (4.85e-5) =	2.7347e-3 (5.54e-5) -	2.7006e-3 (7.33e-5)
DASCMOP3	2	30	5.3819e-3 (1.79e-4) -	5.3298e-3 (1.65e-4) =	5.2909e-3 (1.42e-4) =	5.2451e-3 (5.72e-5) =	5.3103e-3 (8.29e-5) -	5.2621e-3 (9.17e-5)
DASCMOP4	2	30	9.5523e-4 (5.87e-4) -	7.6817e-4 (3.16e-4) +	7.0803e-4 (6.31e-5) =	6.7204e-4 (3.23e-5) =	7.6116e-4 (3.08e-4) =	8.5325e-4 (5.38e-4)
DASCMOP5	2	30	2.0896e-3 (1.34e-4) -	2.0610e-3 (1.20e-4) -	2.0137e-3 (1.48e-4) =	1.9490e-3 (1.33e-4) =	2.0377e-3 (1.38e-4) =	1.9923e-3 (1.46e-4)
DASCMOP6	2	30	5.3528e-3 (1.33e-4) =	5.3534e-3 (1.72e-4) =	5.3085e-3 (1.12e-4) =	5.3153e-3 (1.77e-4) =	5.4108e-3 (3.53e-4) =	5.2979e-3 (1.09e-4) =
DASCMOP7	3	30	2.4199e-2 (7.52e-4) -	2.3654e-2 (6.65e-4) -	2.3495e-2 (7.03e-4) =	2.2977e-2 (7.49e-4) =	2.3378e-2 (9.79e-4) =	2.3186e-2 (7.87e-4)
DASCMOP8	3	30	1.8737e-2 (6.39e-4) -	1.8192e-2 (6.29e-4) -	1.7880e-2 (9.20e-4) =	1.7242e-2 (6.14e-4) =	1.7915e-2 (6.78e-4) -	1.7505e-2 (7.64e-4)
DASCMOP9	3	30	1.7130e-2 (4.98e-4) =	1.6784e-2 (5.31e-4) =	1.6816e-2 (5.20e-4) =	1.6607e-2 (6.22e-4) +	1.7114e-2 (4.77e-4) =	1.7005e-2 (6.00e-4)
LIRCMOP1	2	30	9.5847e-3 (1.52e-3) -	9.3103e-3 (1.45e-3) -	6.2620e-3 (4.78e-4) =	6.2691e-3 (7.45e-4) =	6.2950e-3 (6.88e-4) =	6.2222e-3 (6.41e-4) =
LIRCMOP2	2	30	8.7542e-3 (7.43e-4) -	8.5585e-3 (1.26e-3) -	6.7387e-3 (8.92e-4) =	6.4497e-3 (7.05e-4) =	6.4760e-3 (6.80e-4) =	6.6528e-3 (6.68e-4)
LIRCMOP3	2	30	5.6561e-3 (2.02e-3) -	5.3157e-3 (1.45e-3) -	3.8615e-3 (5.10e-4) -	3.7262e-3 (1.33e-3) =	3.7855e-3 (5.25e-4) -	3.4726e-3 (4.91e-4) =
LIRCMOP4	2	30	6.2693e-3 (1.43e-3) -	6.3349e-3 (1.61e-3) -	4.5144e-3 (7.35e-4) =	4.3479e-3 (7.74e-4) =	4.6303e-3 (8.67e-4) =	4.4676e-3 (1.41e-3)
LIRCMOP5	2	30	6.3164e-3 (3.96e-4) =	6.2088e-3 (3.62e-4) =	6.3173e-3 (4.25e-4) =	6.4729e-3 (4.52e-4) =	6.2131e-3 (3.60e-4) =	6.2788e-3 (3.92e-4)
LIRCMOP6	2	30	5.6526e-3 (3.71e-4) =	5.7734e-3 (4.17e-4) =	5.8330e-3 (4.10e-4) =	5.6462e-3 (2.65e-4) =	5.7430e-3 (3.80e-4) =	5.6917e-3 (3.90e-4)
LIRCMOP7	2	30	5.3528e-3 (2.46e-4) =	5.3696e-3 (2.67e-4) =	5.3853e-3 (2.58e-4) =	5.1315e-3 (2.61e-4) =	5.3790e-3 (3.40e-4) =	5.2501e-3 (2.96e-4)
LIRCMOP8	2	30	5.4743e-3 (4.02e-4) -	5.4949e-3 (3.46e-4) -	5.3840e-3 (2.88e-4) -	5.1170e-3 (2.13e-4) =	5.2632e-3 (3.73e-4) -	5.0304e-3 (2.39e-4) =
LIRCMOP9	2	30	1.1939e-2 (8.33e-3) +	2.3858e-2 (2.04e-2) =	3.6610e-2 (2.14e-2) =	4.2120e-2 (1.91e-2) =	4.3413e-2 (1.85e-2) =	3.3354e-2 (2.15e-2)
LIRCMOP10	2	30	6.5173e-3 (4.64e-4) -	6.6241e-3 (3.91e-4) -	5.8166e-3 (3.25e-4) =	5.7738e-3 (2.99e-4) =	5.8223e-3 (3.06e-4) =	5.7352e-3 (3.12e-4) =
LIRCMOP11	2	30	8.8347e-4 (1.58e-4) -	8.3964e-4 (1.09e-4) -	7.2713e-4 (1.53e-4) =	7.0036e-4 (1.10e-4) =	7.5780e-4 (1.37e-4) =	7.2434e-4 (1.50e-4)
LIRCMOP12	2	30	1.2107e-3 (3.34e-4) -	1.0721e-3 (3.10e-4) -	1.0019e-3 (5.54e-4) =	8.9459e-4 (4.37e-4) =	8.6492e-4 (4.51e-4) =	9.9532e-4 (7.97e-4)
LIRCMOP13	3	30	6.0167e-2 (1.45e-3) =	6.0319e-2 (2.17e-3) =	6.0091e-2 (1.79e-3) =	1.4417e-1 (3.17e-1) =	1.0232e-1 (2.28e-1) =	1.1238e-1 (2.32e-1)
LIRCMOP14	3	30	4.9223e-2 (1.35e-3) =	4.9496e-2 (1.28e-3) =	4.9116e-2 (1.55e-3) =	1.1862e-1 (2.69e-1) =	4.9413e-2 (1.63e-3) =	1.8769e-1 (3.76e-1)

+/-=

1/15/17

1/12/20

0/2/31

2/0/31

0/7/26

TABLE SXIV
THE AVERAGE IGD RESULTS OF THE ABLATION EXPERIMENT ON THREE TEST BENCHMARK SUITES.

Problem	M	D	ACEMT_ACST	ACEMT_ACR	ACEMT
CF1	2	10	1.2071e-3 (2.18e-4) +	2.6677e-3 (4.31e-4) -	1.3143e-3 (1.92e-4)
CF2	2	10	2.5661e-3 (7.65e-5) +	2.7958e-3 (1.10e-4) -	2.6967e-3 (8.37e-5)
CF3	2	10	1.9901e-1 (8.14e-2) =	1.9570e-1 (8.60e-2) =	1.6969e-1 (8.70e-2)
CF4	2	10	1.4967e-2 (5.48e-3) =	2.2844e-2 (8.26e-3) -	1.7350e-2 (6.72e-3)
CF5	2	10	1.2258e-1 (9.17e-2) =	1.4536e-1 (7.35e-2) -	9.1006e-2 (3.03e-2)
CF6	2	10	2.2927e-2 (6.55e-3) -	1.3936e-2 (2.69e-3) =	1.3571e-2 (2.02e-3)
CF7	2	10	1.1302e-1 (5.83e-2) -	1.3777e-1 (1.36e-1) =	8.4785e-2 (5.77e-2)
CF8	3	10	1.6220e-1 (2.70e-2) -	1.3365e-1 (1.22e-2) +	1.4527e-1 (3.14e-2)
CF9	3	10	7.4715e-2 (1.11e-2) =	7.0895e-2 (6.12e-3) =	7.2146e-2 (9.87e-3)
CF10	3	10	2.0611e-1 (9.76e-2) =	2.1785e-1 (1.08e-1) =	2.2508e-1 (8.96e-2)
DASCMOP1	2	30	2.5664e-2 (1.21e-1) -	2.7945e-3 (1.53e-4) =	2.9136e-3 (2.60e-4)
DASCMOP2	2	30	3.9359e-3 (6.72e-5) =	3.9306e-3 (5.00e-5) =	3.9413e-3 (6.58e-5)
DASCMOP3	2	30	1.9686e-2 (7.93e-4) -	1.6748e-2 (3.42e-3) =	1.6759e-2 (3.40e-3)
DASCMOP4	2	30	1.1796e-3 (8.67e-5) +	1.4288e-3 (7.43e-4) =	1.2426e-3 (1.34e-4)
DASCMOP5	2	30	2.8364e-3 (1.04e-4) =	2.8052e-3 (7.65e-5) +	2.8697e-3 (1.09e-4)
DASCMOP6	2	30	2.8975e-2 (5.72e-2) =	1.9066e-2 (1.76e-3) =	1.7548e-2 (3.18e-3)
DASCMOP7	3	30	3.0543e-2 (7.96e-4) =	3.0235e-2 (7.80e-4) =	3.0332e-2 (8.09e-4)
DASCMOP8	3	30	3.9732e-2 (9.14e-4) -	3.9019e-2 (9.64e-4) =	3.9242e-2 (8.30e-4)
DASCMOP9	3	30	3.9324e-2 (7.05e-4) =	3.9321e-2 (8.07e-4) =	3.9355e-2 (7.89e-4)
LIRCMOP1	2	30	1.4557e-1 (4.51e-2) -	8.6846e-3 (1.03e-3) =	8.2244e-3 (8.14e-4)
LIRCMOP2	2	30	1.1330e-1 (4.11e-2) -	7.2859e-3 (7.35e-4) =	7.3765e-3 (7.46e-4)
LIRCMOP3	2	30	2.1622e-1 (6.62e-2) -	4.8293e-3 (6.43e-4) =	4.8759e-3 (8.80e-4)
LIRCMOP4	2	30	1.9518e-1 (4.95e-2) -	4.5424e-3 (9.32e-4) =	4.6434e-3 (7.92e-4)
LIRCMOP5	2	30	6.8763e-3 (1.12e-3) =	5.5496e-2 (2.21e-1) -	6.7303e-3 (5.19e-4)
LIRCMOP6	2	30	6.2003e-3 (4.44e-4) +	5.6066e-1 (6.23e-1) -	6.4615e-3 (3.27e-4)
LIRCMOP7	2	30	7.2626e-3 (9.15e-4) =	1.1682e-2 (1.43e-2) =	7.1721e-3 (5.58e-4)
LIRCMOP8	2	30	7.0264e-3 (3.04e-4) =	1.1837e-2 (2.62e-2) =	7.0641e-3 (2.75e-4)
LIRCMOP9	2	30	3.2851e-1 (1.78e-1) -	7.3626e-2 (2.03e-2) =	6.0417e-2 (3.13e-2)
LIRCMOP10	2	30	6.0906e-3 (5.50e-4) =	7.7099e-3 (5.09e-4) -	6.1379e-3 (2.99e-4)
LIRCMOP11	2	30	7.0605e-2 (7.05e-2) =	2.8438e-3 (6.63e-4) -	2.5686e-3 (2.59e-4)
LIRCMOP12	2	30	9.6616e-2 (5.49e-2) -	8.1661e-3 (3.62e-3) -	3.7358e-3 (5.29e-4)
LIRCMOP13	3	30	1.0046e-1 (1.15e-3) +	1.3108e+0 (1.50e-3) -	1.0148e-1 (1.46e-3)
LIRCMOP14	3	30	9.7341e-2 (7.58e-4) =	1.2674e+0 (1.61e-3) -	1.7562e-1 (2.96e-1)
+/-=		5/12/16		2/11/20	

TABLE SXV
THE AVERAGE HV RESULTS OF THE ABLATION EXPERIMENT ON THREE TEST BENCHMARK SUITES.

Problem	M	D	ACEMT_ACST	ACEMT_ACR	ACEMT
CF1	2	10	7.7464e-1 (2.64e-4) +	7.7286e-1 (5.21e-4) -	7.7451e-1 (2.34e-4)
CF2	2	10	8.8877e-1 (2.67e-4) +	8.8848e-1 (2.64e-4) =	8.8854e-1 (2.74e-4)
CF3	2	10	4.1249e-1 (5.87e-2) =	4.1451e-1 (5.37e-2) =	4.3815e-1 (5.99e-2)
CF4	2	10	7.1690e-1 (7.18e-3) =	7.0729e-1 (1.08e-2) -	7.1393e-1 (8.35e-3)
CF5	2	10	5.8873e-1 (8.15e-2) =	5.4895e-1 (6.91e-2) -	6.0508e-1 (3.82e-2)
CF6	2	10	8.9280e-1 (8.03e-3) -	8.9656e-1 (5.90e-3) -	9.0008e-1 (2.88e-3)
CF7	2	10	7.5712e-1 (7.55e-2) -	7.3666e-1 (1.39e-1) =	7.8741e-1 (8.39e-2)
CF8	3	10	6.7303e-1 (5.84e-2) -	7.1604e-1 (2.31e-2) =	7.0144e-1 (5.24e-2)
CF9	3	10	8.2164e-1 (2.24e-2) =	8.1679e-1 (1.60e-2) -	8.2538e-1 (1.49e-2)
CF10	3	10	5.7393e-1 (1.54e-1) =	5.4250e-1 (1.61e-1) =	5.2650e-1 (1.49e-1)
DASCMOP1	2	30	3.5517e-1 (3.60e-2) =	3.6203e-1 (3.34e-4) =	3.6190e-1 (4.94e-4)
DASCMOP2	2	30	5.0506e-1 (5.66e-5) =	5.0509e-1 (3.67e-5) +	5.0505e-1 (4.86e-5)
DASCMOP3	2	30	4.5526e-1 (3.70e-4) =	4.5536e-1 (1.43e-4) =	4.5537e-1 (1.81e-4)
DASCMOP4	2	30	3.4745e-1 (1.74e-4) =	3.4681e-1 (2.14e-3) =	3.4734e-1 (2.58e-4)
DASCMOP5	2	30	4.9927e-1 (1.29e-4) +	4.9915e-1 (1.96e-4) +	4.9902e-1 (2.16e-4)
DASCMOP6	2	30	4.4752e-1 (4.35e-2) =	4.5545e-1 (7.88e-5) =	4.5543e-1 (8.59e-5)
DASCMOP7	3	30	4.5443e-1 (4.12e-4) =	4.5449e-1 (4.54e-4) =	4.5429e-1 (4.42e-4)
DASCMOP8	3	30	3.7439e-1 (3.46e-4) =	3.7448e-1 (4.88e-4) +	3.7420e-1 (4.17e-4)
DASCMOP9	3	30	3.7470e-1 (3.57e-4) =	3.7485e-1 (3.12e-4) +	3.7464e-1 (3.30e-4)
LIRCMOP1	2	30	2.6725e-1 (3.45e-2) -	3.8607e-1 (4.06e-4) -	3.8637e-1 (3.23e-4)
LIRCMOP2	2	30	4.2602e-1 (3.56e-2) -	5.0867e-1 (3.73e-4) =	5.0860e-1 (3.85e-4)
LIRCMOP3	2	30	2.1829e-1 (2.82e-2) -	3.4800e-1 (4.85e-4) =	3.4810e-1 (4.62e-4)
LIRCMOP4	2	30	3.4172e-1 (2.64e-2) -	4.5938e-1 (5.97e-4) =	4.5933e-1 (6.57e-4)
LIRCMOP5	2	30	4.2530e-1 (1.65e-3) =	4.0695e-1 (7.76e-2) -	4.2595e-1 (3.13e-4)
LIRCMOP6	2	30	3.3148e-1 (2.54e-4) +	1.8056e-1 (1.52e-1) -	3.3132e-1 (1.69e-4)
LIRCMOP7	2	30	4.5084e-1 (1.45e-3) =	4.4704e-1 (1.05e-2) -	4.5088e-1 (1.04e-3)
LIRCMOP8	2	30	4.5124e-1 (1.39e-4) =	4.4834e-1 (1.52e-2) -	4.5119e-1 (1.22e-4)
LIRCMOP9	2	30	6.4241e-1 (7.76e-2) -	7.5486e-1 (5.62e-3) =	7.5808e-1 (8.66e-3)
LIRCMOP10	2	30	9.1617e-1 (3.47e-4) +	9.1513e-1 (3.35e-4) -	9.1603e-1 (2.22e-4)
LIRCMOP11	2	30	8.5968e-1 (4.63e-2) =	9.0375e-1 (5.08e-4) -	9.0393e-1 (1.61e-4)
LIRCMOP12	2	30	7.8808e-1 (2.50e-2) -	8.2797e-1 (1.77e-3) -	8.3011e-1 (2.22e-4)
LIRCMOP13	3	30	8.7081e-1 (2.03e-3) +	3.1091e-3 (2.23e-3) -	8.6676e-1 (2.80e-3)
LIRCMOP14	3	30	8.8288e-1 (1.85e-3) +	7.9768e-3 (2.51e-3) -	8.2287e-1 (2.23e-1)
+/-=		7/9/17		4/15/14	

TABLE SXVI
THE AVERAGE IGD+ RESULTS OF THE ABLATION EXPERIMENT ON THREE TEST BENCHMARK SUITES.

Problem	M	D	ACEMT_ACST	ACEMT_ACR	ACEMT
CF1	2	10	1.2071e-3 (2.18e-4) +	2.6677e-3 (4.31e-4) -	1.3143e-3 (1.92e-4)
CF2	2	10	2.0858e-3 (8.71e-5) +	2.3766e-3 (1.11e-4) -	2.2351e-3 (9.90e-5)
CF3	2	10	1.7395e-1 (6.41e-2) =	1.6768e-1 (6.80e-2) =	1.4911e-1 (6.74e-2)
CF4	2	10	1.3001e-2 (4.45e-3) =	1.9325e-2 (6.73e-3) -	1.4906e-2 (5.31e-3)
CF5	2	10	9.5837e-2 (6.75e-2) =	1.2149e-1 (5.99e-2) -	7.5617e-2 (2.65e-2)
CF6	2	10	1.4382e-2 (3.28e-3) -	9.8884e-3 (1.61e-3) =	9.4677e-3 (9.39e-4)
CF7	2	10	8.5236e-2 (4.90e-2) -	1.1620e-1 (1.26e-1) =	6.7061e-2 (4.83e-2)
CF8	3	10	1.1817e-1 (2.41e-2) -	9.9763e-2 (9.62e-3) =	1.0607e-1 (2.35e-2)
CF9	3	10	4.3061e-2 (6.54e-3) =	4.4624e-2 (4.74e-3) =	4.3226e-2 (5.89e-3)
CF10	3	10	1.5189e-1 (7.46e-2) =	1.7407e-1 (1.01e-1) =	1.7215e-1 (7.75e-2)
DASCMOP1	2	30	1.7147e-2 (8.56e-2) =	1.4344e-3 (5.19e-5) +	1.4824e-3 (7.17e-5)
DASCMOP2	2	30	2.6745e-3 (8.39e-5) =	2.6423e-3 (5.94e-5) +	2.6970e-3 (7.82e-5)
DASCMOP3	2	30	5.4360e-3 (6.74e-4) =	5.2450e-3 (7.57e-5) =	5.2672e-3 (8.46e-5)
DASCMOP4	2	30	6.4053e-4 (1.84e-5) +	7.7996e-4 (4.47e-4) -	6.8360e-4 (3.81e-5)
DASCMOP5	2	30	1.8442e-3 (9.83e-5) +	1.8327e-3 (7.26e-5) +	1.9304e-3 (1.01e-4)
DASCMOP6	2	30	1.6015e-2 (5.92e-2) -	5.2454e-3 (5.46e-5) =	5.2852e-3 (9.25e-5)
DASCMOP7	3	30	2.3002e-2 (8.89e-4) =	2.2841e-2 (8.33e-4) =	2.2977e-2 (8.26e-4)
DASCMOP8	3	30	1.7127e-2 (6.59e-4) +	1.7385e-2 (6.36e-4) =	1.7496e-2 (7.19e-4)
DASCMOP9	3	30	1.6687e-2 (5.58e-4) =	1.6691e-2 (5.93e-4) =	1.6794e-2 (5.45e-4)
LIRCMOP1	2	30	1.2652e-1 (3.85e-2) -	5.6531e-3 (5.19e-4) -	5.3125e-3 (4.12e-4)
LIRCMOP2	2	30	6.5621e-2 (2.64e-2) -	5.5996e-3 (4.51e-4) =	5.6333e-3 (4.90e-4)
LIRCMOP3	2	30	1.8195e-1 (5.03e-2) -	2.9251e-3 (4.53e-4) =	2.9593e-3 (5.30e-4)
LIRCMOP4	2	30	1.1821e-1 (3.26e-2) -	3.6627e-3 (7.54e-4) =	3.7074e-3 (6.85e-4)
LIRCMOP5	2	30	6.4916e-3 (1.10e-3) =	5.3611e-2 (2.20e-1) -	6.3832e-3 (5.44e-4)
LIRCMOP6	2	30	5.5399e-3 (4.70e-4) +	5.4334e-1 (6.28e-1) -	5.8269e-3 (3.37e-4)
LIRCMOP7	2	30	5.2797e-3 (9.00e-4) =	9.2531e-3 (1.21e-2) =	5.2835e-3 (5.77e-4)
LIRCMOP8	2	30	5.0704e-3 (3.30e-4) =	9.1453e-3 (2.17e-2) =	5.1441e-3 (2.57e-4)
LIRCMOP9	2	30	1.9187e-1 (9.61e-2) -	5.0066e-2 (1.34e-2) =	4.1413e-2 (2.07e-2)
LIRCMOP10	2	30	5.7683e-3 (5.73e-4) =	7.4988e-3 (5.20e-4) -	5.8511e-3 (3.23e-4)
LIRCMOP11	2	30	5.6857e-2 (5.85e-2) =	1.0136e-3 (6.63e-4) -	7.4322e-4 (2.60e-4)
LIRCMOP12	2	30	6.9670e-2 (4.04e-2) -	5.4785e-3 (3.62e-3) -	1.0198e-3 (5.31e-4)
LIRCMOP13	3	30	5.8429e-2 (1.98e-3) +	1.3099e+0 (1.51e-3) -	6.1570e-2 (2.72e-3)
LIRCMOP14	3	30	4.7781e-2 (1.51e-3) +	1.2663e+0 (1.50e-3) -	1.3008e-1 (3.08e-1)
+/-=					
8/10/15					
3/13/17					

TABLE SXVII
THE AVERAGE HV RESULTS OBTAINED BY ACEM^T AND ITS FOURTEEN COMPETITORS ON THE RWMOP TEST SUITE.