Supplemental file of " Multi-Layer Competitive-Cooperative Framework for Performance Enhancement of Differential Evolution"

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Part I
Pseudocodes of Four MLCC Variants.

Descriptions of MLCC-SI

As seen from **Algorithm S-1**, each individual in MLCC-SI has independent layer associated operatioins and parameters. For the superior individuals, lines 11-19 generate two trial vectors for each individual by simultaneously using SHADE [2] and IDE [1]. As required by SHADE, if the generated offspring is better than the target vector, its algorithmic configuration is updated. (lines 14-16). Afterward, lines 20-26 are used to select the better one as offspring to compete with the target vector. If the offspring successfully replaces the target vector, its corresponding layer preference is set as its generation optimizer (line 23). For the inferior solutions, they are evolved following lines 28-46 based on the individual preference. Lines 49-51 randomly remove some individuals from the external archive to keep the archive size $|A| \le NP$. Line 52 updates the memory M_F and M_{CR} based on the successful parameter archives S_F and S_{CR} respectively, following the original proposal in SHADE [2]. When $G \ge G_T$, line 53 changes the setting of SR_T to distinguish earlier and later stages and determine the IDM mutation strategy (lines 17-19 and 38-40), which are the same as those done in IDE [1].

Algorithm S-1. MLCC-SI

1: Initialize a population $P_0 = \{\vec{x}_{i,0}, i \in \{1,2,\cdots NP\}\}$,

2: Initialize SHADE layer: Set memory M_F, M_{CR}, set history lengeth H, initialize history index k = 1, initialize external archive $A = \varnothing$;

3: Initialize IDE layer: Set maximum generation number G_{max}, set consecutive generations $T = 1000D/NP$, generation index threshold $G_T = 5 \times T$, the success ratio threshold $SR_T = 0$, Accumulation = 0, Stage = eariler stage;

4: Initialize the individual preference $\{IP_{i,0} = ceil(rand_i(0,1) \times 2), i \in \{1,2,\cdots NP\}\}$, set generation count $G = 0$, set $N = 0.05$, set SHADE as method 1, IDE as method 2;

5: **While** the stopping criteria are not satisfied, **Do**

6: Determine the fitness ranking $FR(i)$, $i \in \{1,2,\cdots NP\}$ of each individual; set $top_G = ceil(rand(0,1) \times NP \times N)$, initialize success count $SC = 0$;

7: Set $S_F = \varnothing$, $S_{CR} = \varnothing$; (For SHADE layer)

8: Classify the population copy of IDE layer into superior (*S*) and inferior (*I*) subpopulations based on fitness (See **Procedure 1**); (For IDE layer)

9: **For** i = 1: NP **Do**

10: **If** $FR(i) \le top_G$

11: For $\vec{x}_{i,G}$, generate two trial vectors $\vec{u}_{i^m,G}, m \in \{1,2\}$ by using SHADE and IDE, respectively as follows:

---------- **For SHADE Layer** ----------

12: $r_i = randint[1,H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i}, 0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i}, 0.1)$, where *randc(a,b)* and *randn(a,b)* are Cauchy distribution and normal distribution with location parameter *a* and scale parameter *b*, respectively.

13: Generate trial vector $\vec{u}_{i^1,G}$ via current-to-*p*best/1/bin [2] using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;

14: **If** $f(\vec{u}_{i^1,G}) \le f(\vec{x}_{i,G})$

15: $S_F \leftarrow F^{SHA}{}_{i,G}$, $S_{CR} \leftarrow CR^{SHA}{}_{i,G}$;

16: **End If**

---------- **For IDE Layer** ----------

17: Set $o = i$ when Stage = eariler stage;

18: $F^{IDE}{}_{o,G} = randn(FR(o)/NP), 0.1)$, $CR^{IDE}{}_{i,G} = randn(FR(i)/NP), 0.1)$;

19: Generate trial vector $\vec{u}_{i^2,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{IDE}{}_{o,G}$ and $CR^{IDE}{}_{i,G}$;

20: Choose the better trial vector $\vec{u}_{i^b,G}$ in terms of fitness from $\vec{u}_{i^m,G}, m \in \{1,2\}$,where *b* indicates the index of the better method;

21: **If** $f(\vec{u}_{i^b,G}) \le f(\vec{x}_{i,G})$

22: $\vec{x}_{i,G+1} = \vec{u}_{i^b,G}$, $A \leftarrow \vec{x}_{i,G}$, $SC = SC + 1$;

23: $IP_{i,G+1} = b$;

24: **Else**
25: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$;
26: **End If**
27: **Else If** $FR(i) > top_G$
28: For $\vec{x}_{i,G}$,
29: **If** $IP_{i,G} = 1$

---------- **For SHADE Layer** ----------

30: $r_i = randint[1, H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i}, 0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i}, 0.1)$;
31: Generate trial vector $\vec{u}_{i,G}$ via current-to-*p*best/1/bin [2] using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;
32: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$
33: $S_F \leftarrow F^{SHA}{}_{i,G}$, $S_{CR} \leftarrow CR^{SHA}{}_{i,G}$, $A \leftarrow \vec{x}_{i,G}$,
$\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $SC = SC + 1$;
34: **Else**
35: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 2$;
36: **End If**

37: **Else If** $IP_{i,G} = 2$

---------- **For IDE Layer** ----------

38: Set $o = i$ when Stage = eariler stage;
39: $F^{IDE}{}_{o,G} = randn(FR(o)/NP), 0.1)$, $CR^{IDE}{}_{i,G} = randn(FR(i)/NP), 0.1)$;
40: Generate trial vector $\vec{u}_{i,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{IDE}{}_{o,G}$ and $CR^{IDE}{}_{i,G}$;
41: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$
42: $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $SC = SC + 1$;
43: **Else**
44: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 1$;
45: **End If**

46: **End If**
47: **End If**
48: **End For**
49: **If** $|A| > NP$
50: randomly delete $|A| - NP$ individuals from A;
51: **End If**
52: Update M_F and M_{CR} based on S_F and S_{CR}, respectively (See **Procedure 3**); (For SHADE layer)
53: Insert **Procedure 4** here. (For IDE layer)
54: $G = G + 1$;
55: **End While**

Procedure 1: Classify the population copy of IDE layer into superior (*S*) and inferior (*I*) subpopulations based on fitness [1]

The proportion of superior individuals is set as

$$ps = 0.1 + 0.9 \times 10^{5(G/G_{\max} - 1)}$$

Where G is the current generation index and G_{max} is the maximum genereation number.

Procedure 2: IDM mutation strategy [1]

$$\vec{v}_{i,G} = \vec{x}_{o,G} + \begin{cases} F^{IDE}{}_{o,G} \cdot (\vec{x}_{r_1,G} - \vec{x}_{o,G}) + F^{IDE}{}_{o,G} \cdot (\vec{x}_{r_2,G} - \vec{d}_{r_3,G}) & o \in S \\ F^{IDE}{}_{o,G} \cdot (\vec{x}_{better,G} - \vec{x}_{o,G}) + F^{IDE}{}_{o,G} \cdot (\vec{x}_{r_2,G} - \vec{d}_{r_3,G}) & o \in I \end{cases}$$

$$o \neq r_1 \neq r_2 \neq r_3$$

Where o, r_1, r_2 and r_3 are selected from the range [1, NP] and are mutually different, *better* is the index of a individual selected from the superior subpopulation S, $\vec{d}_{r_3,G}$ is perturbation vector to avoid local optimal with each dimension j determined by

$$d^{j}{}_{r_3,G} = \begin{cases} L^j + rand(0,1) \cdot (U^j - L^j) & if \ \ rand_i^j(0,1) < p_d \\ x^j{}_{r_3,G} & otherwise \end{cases}$$

Where U^j and L^j are upper and lower bound of dimension j, $rand_i^j(0,1)$ is a uniformly distributed random number within (0,1), and p_d is set as $0.1 \times ps$.

Procedure 3: Update M_F and M_{CR} [2]

$$M_{F,k,G+1} = \begin{cases} mean_{W_L}(S_F) & if \ S_F \neq \varnothing \\ M_{F,k,G} & otherwise \end{cases}$$

$$M_{CR,k,G+1} = \begin{cases} mean_{W_A}(S_{CR}) & if \ S_{CR} \neq \varnothing \\ M_{CR,k,G} & otherwise \end{cases}$$

Where $mean_{W_A}(S_{CR}) = \sum_{m=1}^{|S_{CR}|} w_m \cdot S_{CR,m}$, $\quad mean_{W_L}(S_F) = \dfrac{\sum_{m=1}^{|S_F|} w_m \cdot S^2{}_{F,m}}{\sum_{m=1}^{|S_F|} w_m \cdot S_{F,m}}$,

$w_m = \dfrac{\Delta f_m}{\sum_{m=1}^{|S_{CR}|} \Delta f_m}$ where $\Delta f_m = \left| f(\vec{u}_{m,G}) - f(\vec{x}_{m,G}) \right|$

If $S_F \neq \varnothing$ and $S_{CR} \neq \varnothing$
  $k = k + 1$;
  If $k > H$
    $k = 1$;
  End If
End If

Procedure 4: Detemine earlier or latter stages [1]

1: Success rate $SR = SC/NP$;
2: **If** $G < G_T$
3: **If** $SR = 0$ // $SR_T = 0$ for eariler stage
4: Accumulation = Accumulation + 1;
5: **Else**
6: Accumulation = 0;
7: **End If**
8: **If** Accumulation $\geq T$
9: **If** Stage = eariler stage
10: Set Stage = later stage;
11: **End If**
12: **End If**
13: **Else**

14: **If** $SR \leq 0.1$ // $SR_T = 0.1$ for later stage
15: Accumulation = Accumulation + 1;
16: **Else**
17: Accumulation = 0;
18: **End If**
19: **If** Accumulation $\geq T$
20: **If** Stage = eariler stage
21: Set Stage = later stage;
22: **End If**
23: **End If**
24: **End If**

Procedure 5: Generate $F^{BiD}_{i,G}$ and $CR^{BiD}_{i,G}$ for each individual i according to bimodal parameter sample [3].

$$F^{BiD}_{i,G} = \begin{cases} rand_{C_i}(0.65, 0.1) & if\ rand(0,1) < 0.5 \\ rand_{C_i}(1.0, 0.1) & otherwise \end{cases}$$

$$CR^{BiD}_{i,G} = \begin{cases} rand_{C_i}(0.1, 0.1) & if\ rand(0,1) < 0.5 \\ rand_{C_i}(0.95, 0.1) & otherwise \end{cases}$$

Where $rand_{C_i}(a,b)$ is a random number for indiviudal i, generated by a Cauchy distribution with location parameter a and scale parameter b.

Descriptions of MLCC-SBi

As seen from **Algorithm S-2**, the two layers in MLCC-SBi have the same generation strategy but different parameter strategies, i.e SHA for SHADE layer and BiD for BiDE layer. For the superior individuals, lines 10-21 generate two trial vectors for each individual by simultaneously using SHADE and BiDE. As required by SHA, if the generated offspring is better than the target vector, its algorithmic configuration is updated (lines 13-15). As for BiD, its algorithmic configuration is updated according to comparision result of the offspring vector and the target vector (lines 17-21). Specifically, if the offspring vector is better than the target vector, the parameters are preserved to the next generation (line 18), otherwise, the parameters are regenerated by the bimodal parameter sample (line 20). Afterward, lines 22-28 are used to select the better one as offspring to compete with the target vector. If the offspring successfully replaces the target vector, its corresponding layer preference is set as its generation optimizer (line 25). For the inferior solutions, they are evolved following lines 30-48 based on the individual preference. Lines 50-52 randomly remove some individuals from the external archive to keep the archive size $|A| \leq NP$. Line 53 updates the memory M_F and M_{CR} based on the successful parameter archives S_F and S_{CR} respectively, following the original proposal in SHADE [2].

Algorithm S-2. MLCC-SBi

1: Initialize a population $P_0 = \{\vec{x}_{i,0}, i \in \{1,2,\cdots NP\}\}$,

2: Initialize SHADE layer: Set memory M_F, M_{CR}, set history lengeth H, initialize history index k = 1, initialize external archive $A = \varnothing$;

3: Initialize BiDE layer: Generate $F^{BiD}_{i,G}$ and $CR^{BiD}_{i,G,}$ $i \in \{1,2,\cdots NP\}$ according to bimodal parameter sample. (See **Procedure 5**)

4: Initialize the individual preference $\{IP_{i,0} = ceil(rand_i(0,1) \times 2), i \in \{1,2,\cdots NP\}\}$, set generation count G = 0, set N = 0.05, set SHADE as method 1, BiDE as method 2;

5: **While** the stopping criteria are not satisfied, **Do**

6: Determine the fitness ranking $FR(i)$, $i \in \{1,2,\cdots NP\}$ of each individual, set $top_G = ceil(rand(0,1) \times NP \times N)$;

7: Set $S_F = \varnothing$, $S_{CR} = \varnothing$; (For SHADE layer)

8: **For** i = 1: NP **Do**
9: **If** $FR(i) \le top_G$
10: For $\vec{x}_{i,G}$, generate two trial vectors $\vec{u}_{i^m,G}, m \in \{1,2\}$ by using SHADE and BiDE, respectively as follows:
---------- **For SHADE Layer** ----------
11: $r_i = randint[1,H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i},0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i},0.1)$;
12: Generate trial vector $\vec{u}_{i^1,G}$ via current-to-$p$best/1/bin [2] using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;
13: **If** $f(\vec{u}_{i^1,G}) \le f(\vec{x}_{i,G})$
14: $S_F \leftarrow F^{SHA}{}_{i,G}, S_{CR} \leftarrow CR^{SHA}{}_{i,G}$;
15: **End If**

---------- **For BiDE Layer** ----------
16: Generate trial vector $\vec{u}_{i^2,G}$ via current-to-$p$best/1/bin [2] using $F^{BiD}{}_{i,G}$ and $CR^{BiD}{}_{i,G}$;
17: **If** $f(\vec{u}_{i^2,G}) \le f(\vec{x}_{i,G})$
18: $F^{BiD}{}_{i,G+1} = F^{BiD}{}_{i,G}$, $CR^{BiD}{}_{i,G+1} = CR^{BiD}{}_{i,G}$;
19: **Else**
20: Generate $F^{BiD}{}_{i,G+1}$ and $CR^{BiD}{}_{i,G+1}$ for individual i according to bimodal parameter sample. (See **Procedure 5**)
21: **End If**

22: Choose the better trial vector $\vec{u}_{i^b,G}$ in terms of fitness from $\vec{u}_{i^m,G}, m \in \{1,2\}$, where b indicates the index of the better method;
23: **If** $f(\vec{u}_{i^b,G}) \le f(\vec{x}_{i,G})$
24: $\vec{x}_{i,G+1} = \vec{u}_{i^b,G}, A \leftarrow \vec{x}_{i,G}$;
25: $IP_{i,G+1} = b$;
26: **Else**
27: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$;
28: **End If**
29: **Else If** $FR(i) > top_G$
30: For $\vec{x}_{i,G}$,
31: **If** $IP_{i,G} = 1$
---------- **For SHADE Layer** ----------
32: $r_i = randint[1,H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i},0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i},0.1)$;
33: Generate trial vector $\vec{u}_{i,G}$ via current-to-$p$best/1/bin [2] using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;
34: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$
35: $\vec{x}_{i,G+1} = \vec{u}_{i,G}, IP_{i,G+1} = IP_{i,G}, A \leftarrow \vec{x}_{i,G}, S_F \leftarrow F^{SHA}{}_{i,G}, S_{CR} \leftarrow CR^{SHA}{}_{i,G}$,;
36: **Else**
37: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 2$;
38: **End If**

39: **Else If** $IP_{i,G} = 2$
---------- **For BiDE Layer** ----------
40: Generate trial vector $\vec{u}_{i,G}$ via current-to-$p$best/1/bin [2] using $F^{BiD}{}_{i,G}$ and $CR^{BiD}{}_{i,G}$;
41: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$
42: $\vec{x}_{i,G+1} = \vec{u}_{i,G}, IP_{i,G+1} = IP_{i,G}, A \leftarrow \vec{x}_{i,G}, F^{BiD}{}_{i,G+1} = F^{BiD}{}_{i,G}$, $CR^{BiD}{}_{i,G+1} = CR^{BiD}{}_{i,G}$;
43: **Else**
44: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 1$;
45: Generate $F^{BiD}{}_{i,G+1}$ and $CR^{BiD}{}_{i,G+1}$ for individual i according to bimodal parameter sample. (See **Procedure 5**)
46: **End If**

47: **End If**

48: **End If**
49: **End For**
50: **If** $|A| > NP$
51: randomly delete $|A| - NP$ individuals from A;
52: **End If**
53: Update M_F and M_{CR} based on S_F and S_{CR}, respectively (See **Procedure 3**); (For SHADE layer)
54: $G = G + 1$;
55: **End While**

Algorithm S-3. MLCC-SIBi

1: Initialize a population $P_0 = \{\vec{x}_{i,0}, i \in \{1,2,\cdots NP\}\}$,

2: Initialize SHADE layer: Set memory M_F, M_{CR}, set history lengeth H, initialize history index $k = 1$, initialize external archive $A = \varnothing$;

3: Initialize IDE layer: Set maximum generation number G_{max}, set consecutive generations $T = 1000D/NP$, generation index threshold $G_T = 5\times T$, the success ratio threshold $SR_T = 0$, Accumulation = 0, Stage = eariler stage;

4: Initialize BiDE layer: Generate $F^{BiD}{}_{i,G}$ and $CR^{BiD}{}_{i,G}$, $i \in \{1,2,\cdots NP\}$ according to bimodal parameter sample. (See **Procedure 5**)

5: Initialize the individual preference $\{IP_{i,0} = ceil(rand_i(0,1)\times 3), i \in \{1,2,\cdots NP\}\}$, set generation count $G = 0$, set $N = 0.05$, set SHADE as method 1, IDE as method 2, BiDE as method 3;

6: **While** the stopping criteria are not satisfied, **Do**

7: Determine the fitness ranking $FR(i)$, $i \in \{1,2,\cdots NP\}$ of each individual; set $top_G = ceil(rand(0,1)\times NP \times N)$, initialize success count $SC = 0$;

8: Set $S_F = \varnothing, S_{CR} = \varnothing$; (For SHADE layer)

9: Classify the population copy of IDE layer into superior (S) and inferior (I) subpopulations based on fitness (See **Procedure 1**); (For IDE layer)

10: **For** $i = 1$: NP **Do**

11: **If** $FR(i) \le top_G$

12: For $\vec{x}_{i,G}$, generate three trial vectors $\vec{u}_{i^m,G}, m \in \{1,2,3\}$ by using SHADE, IDE and BiDE, respectively as follows:

---------- **For SHADE Layer** ----------

13: $r_i = randint[1,H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i}, 0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i}, 0.1)$;

14: Generate trial vector $\vec{u}_{i^1,G}$ via current-to-$p$best/1/bin using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;

15: **If** $f(\vec{u}_{i^1,G}) \le f(\vec{x}_{i,G})$

16: $S_F \leftarrow F^{SHA}{}_{i,G}, S_{CR} \leftarrow CR^{SHA}{}_{i,G}$;

17: **End If**

---------- **For IDE Layer** ----------

18: Set $o = i$ when Stage = eariler stage;

19: $F^{IDE}{}_{o,G} = randn(FR(o)/NP), 0.1)$; $CR^{IDE}{}_{i,G} = randn(FR(i)/NP), 0.1)$;

20: Generate trial vector $\vec{u}_{i^2,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{IDE}{}_{o,G}$ and $CR^{IDE}{}_{i,G}$;

---------- **For BiDE Layer** ----------

21: Generate trial vector $\vec{u}_{i^3,G}$ via current-to-$p$best/1/bin using $F^{BiD}{}_{i,G}$ and $CR^{BiD}{}_{i,G}$;

22: **If** $f(\vec{u}_{i^3,G}) \le f(\vec{x}_{i,G})$

23: $F^{BiD}{}_{i,G+1} = F^{BiD}{}_{i,G}$, $CR^{BiD}{}_{i,G+1} = CR^{BiD}{}_{i,G}$;

24: **Else**

25: Generate $F^{BiD}{}_{i,G+1}$ and $CR^{BiD}{}_{i,G+1}$ for individual i according to bimodal parameter sample. (See **Procedure 5**)

26: **End If**

27: Choose the best trial vector $\vec{u}_{i^b,G}$ in terms of fitness from $\vec{u}_{i^m,G}, m \in \{1,2,3\}$,where *b* indicates the index of the best method;

28: **If** $f(\vec{u}_{i^b,G}) \le f(\vec{x}_{i,G})$

29: $\vec{x}_{i,G+1} = \vec{u}_{i^b,G}$, $A \leftarrow \vec{x}_{i,G}$, $SC = SC + 1$;

30: $IP_{i,G+1} = b$;

31: **Else**

32: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$;

33: **End If**

34: **Else If** $FR(i) > top_G$

35: For $\vec{x}_{i,G}$,

36: **If** $IP_{i,G} = 1$

---------- **For SHADE Layer** ----------

37: $r_i = randint[1, H]$, $F^{SHA}{}_{i,G} = randc_i(M_{F,r_i}, 0.1)$, $CR^{SHA}{}_{i,G} = randn_i(M_{CR,r_i}, 0.1)$;

38: Generate trial vector $\vec{u}_{i,G}$ via current-to-*p*best/1/bin using $F^{SHA}{}_{i,G}$ and $CR^{SHA}{}_{i,G}$;

39: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

40: $S_F \leftarrow F_{i,G}$, $S_{CR} \leftarrow CR_{i,G}$, $A \leftarrow \vec{x}_{i,G}$,
$\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $SC = SC + 1$;

41: **Else**

42: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = ceil(rand(0,1) \times 3) \setminus 1$;

43: **End If**

44: **Else If** $IP_{i,G} = 2$

---------- **For IDE Layer** ----------

45: Set *o* = *i* when Stage = eariler stage;

46: $F^{IDE}{}_{o,G} = randn(FR(o)/NP), 0.1)$, $CR^{IDE}{}_{i,G} = randn(FR(i)/NP), 0.1)$;

47: Generate trial vector $\vec{u}_{i,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{IDE}{}_{o,G}$ and $CR^{IDE}{}_{i,G}$;

48: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

49: $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $SC = SC + 1$;

50: **Else**

51: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = ceil(rand(0,1) \times 3) \setminus 2$;

52: **End If**

53: **Else If** $IP_{i,G} = 3$

---------- **For BiDE Layer** ----------

54: Generate trial vector $\vec{u}_{i,G}$ via current-to-*p*best/1/bin using $F^{BiD}{}_{i,G}$ and $CR^{BiD}{}_{i,G}$;

55: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

56: $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $F^{BiD}{}_{i,G+1} = F^{BiD}{}_{i,G}$, $CR^{BiD}{}_{i,G+1} = CR^{BiD}{}_{i,G}$, $SC = SC + 1$;

57: **Else**

58: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = ceil(rand(0,1) \times 3) \setminus 3$;

59: Generate $F^{BiD}{}_{i,G+1}$ and $CR^{BiD}{}_{i,G+1}$ for individual *i* according to bimodal parameter sample. (See **Procedure 5**)

60: **End If**

61: **End If**

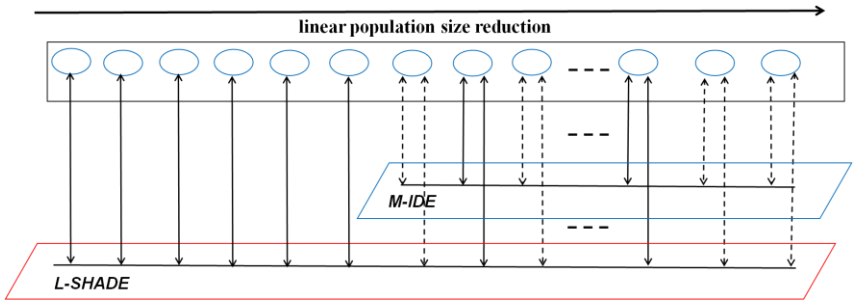
62: **End If**

63: **End For**

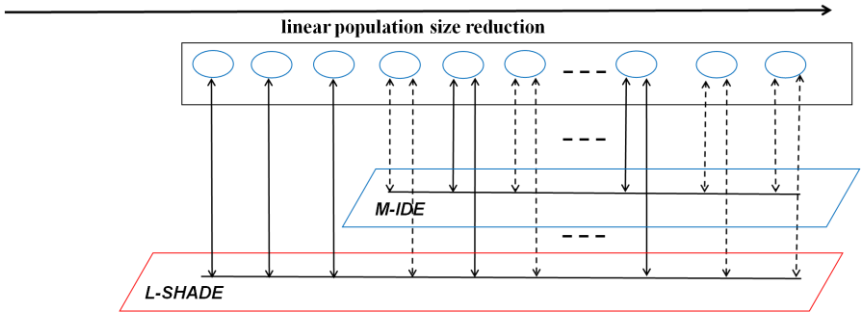
64: **If** $|A| > NP$

65: randomly delete $|A| - NP$ individuals from *A*;

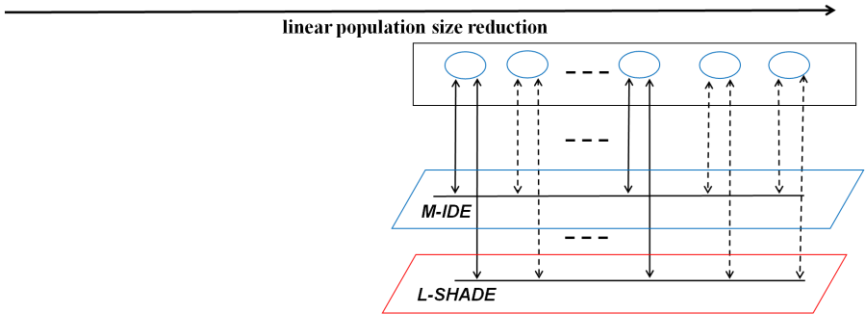
66: **End If**
67: Update M_F and M_{CR} based on S_F and S_{CR}, respectively (See **Procedure 3**); (For SHADE layer)
68: Insert **Procedure 4** here. (For IDE layer)
69: $G = G + 1$;
70: **End While**



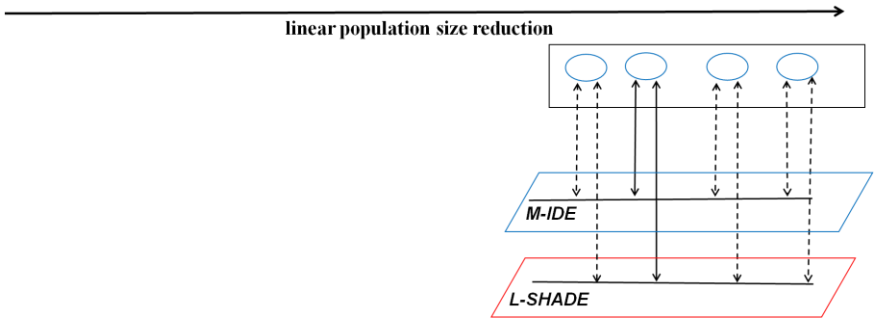
(a) At $G = 0$, layer L-SHADE has a population of $20\times D$ individulas while layer M_IDE has a population of $5\times D$ individulas;



(b) At $G > 0$, when $NP_G \geq 5\times D$ (the initial population size of M_IDE), the population size of L-SHADE decreases by following the liniear population size reduction (LPSR) scheme while the population size of M_IDE remains $5\times D$.



(c) At $G > 0$, when $NP_G < 5\times D$ (the initial population size of M_IDE), the population sizes of L-SHADE and M_IDE both decrease following LPSR scheme.



(d) At the last generation, the population sizes of L-SHADE and M_IDE both decrease to 4, the minimum number of individuals required by mutation operation.

Fig. S1 Graphic illustration of MLCC-L-SI (Algorithm S-4).

Algorithm S-4. MLCC-L-SI

1: Initialize a population $P_0 = \{\vec{x}_{i,0}, i \in \{1,2,\cdots NP^{init}\}\}$, set $NP_0 = NP^{init}$, set NP^{M_IDE}, initialize external archive $A = \varnothing$, initialize the maximum external archive size MAS_0 = ceil(2.6×NP_0), set $NPT_0 = min(NP_0, NP^{M\_IDE})$, set maximum generation number G_{max};

2: Initialize L-SHADE layer: Set memory $M^{LSHA}{}_F$, $M^{LSHA}{}_{CR}$, set history lengeth H^{LSHA}, initialize history index k^{LSHA} = 1;

3: Initialize M_IDE layer: Set memory $M^{M\_IDE}{}_F$, $M^{M\_IDE}{}_{CR}$, set history lengeth H^{M_IDE}, initialize history index k^{M_IDE} = 1, set consecutive generations T = ceil(0.1×G_{max}), generation index threshold G_T = 5×T, the success ratio threshold SR_T = 0, Accumulation = 0, Stage = eariler stage;

4: Initialize the individual preference $\{IP_{i,0} = 1, i \in \{1,2,\cdots NP_0\}\}$, set generation count G = 0, set N = 0.05, set L-SHADE as method 1, M_IDE as method 2;

5: **While** the stopping criteria are not satisfied, **Do**

6: Set $S^{LSHA}{}_F = \varnothing$, $S^{LSHA}{}_{CR} = \varnothing$; (For L-SHADE layer)

7: Set $S^{M\_IDE}{}_F = \varnothing$, $S^{M\_IDE}{}_{CR} = \varnothing$; (For M_IDE layer)

8: Determine the fitness ranking *FR(i)*, $i \in \{1,2,\cdots NPT_G\}$, set $top_G = ceil(rand(0,1) \times NPT_G \times N)$;

9: **For** i = 1: NPT_G **Do**

10: **If** $FR(i) \le top_G$

11: For $\vec{x}_{i,G}$, generate two trial vectors $\vec{u}_{i^m,G}, m \in \{1,2\}$ by using L-SHADE and M_IDE, respectively as follows:

---------- **For L-SHADE Layer** ----------

12: $r^{LSHA}{}_i = randint[1, H^{LSHA}]$, $F^{LSHA}{}_{i,G} = randc_i(M^{LSHA}{}_{F,r^{LSHA}{}_i}, 0.1)$, $CR^{LSHA}{}_{i,G} = randn_i(M^{LSHA}{}_{CR,r^{LSHA}{}_i}, 0.1)$;

13: Generate trial vector $\vec{u}_{i^1,G}$ via current-to-*p*best/1/bin [4] using $F^{LSHA}{}_{i,G}$ and $CR^{LSHA}{}_{i,G}$;

14: **If** $f(\vec{u}_{i^1,G}) \le f(\vec{x}_{i,G})$

15: $S^{LSHA}{}_F \leftarrow F^{LSHA}{}_{i,G}$, $S^{LSHA}{}_{CR} \leftarrow CR^{LSHA}{}_{i,G}$;

16: **End If**

---------- **For M_IDE Layer** ----------

17: Set o = i when Stage = eariler stage;

18: $r^{M\_IDE}{}_i = randint[1, H^{M\_IDE}]$, $F^{M\_IDE}{}_{i,G} = randc_i(M^{M\_IDE}{}_{F,r^{M\_IDE}{}_i}, 0.1)$, $CR^{M\_IDE}{}_{i,G} = randn_i(M^{M\_IDE}{}_{CR,r^{M\_IDE}{}_i}, 0.1)$;

19: Generate trial vector $\vec{u}_{i^2,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{M\_IDE}{}_{i,G}$ and $CR^{M\_IDE}{}_{i,G}$;

20: **If** $f(\vec{u}_{i^2,G}) \le f(\vec{x}_{i,G})$

21: $S^{M\_IDE}{}_F \leftarrow F^{M\_IDE}{}_{i,G}$, $S^{M\_IDE}{}_{CR} \leftarrow CR^{M\_IDE}{}_{i,G}$;

22: **End If**

23: Choose the better trial vector $\vec{u}_{i^b,G}$ in terms of fitness from $\vec{u}_{i^m,G}, m \in \{1,2\}$, where b indicates the index of the better method;

24: **If** $f(\vec{u}_{i^b,G}) \le f(\vec{x}_{i,G})$

25: $\vec{x}_{i,G+1} = \vec{u}_{i^b,G}$, $A \leftarrow \vec{x}_{i,G}$, $SC = SC + 1$;

26: $IP_{i,G+1} = b$;

27: **Else**

28: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$;

29: **End If**

30: **Else If** $FR(i) > top_G$

31: For $\vec{x}_{i,G}$,

32: **If** $IP_{i,G} = 1$

---------- **For L-SHADE Layer** ----------

33: $r^{LSHA}{}_i = randint[1, H^{LSHA}]$, $F^{LSHA}{}_{i,G} = randc_i(M^{LSHA}{}_{F,r^{LSHA}{}_i}, 0.1)$, $CR^{LSHA}{}_{i,G} = randn_i(M^{LSHA}{}_{CR,r^{LSHA}{}_i}, 0.1)$;

34: Generate trial vector $\vec{u}_{i,G}$ via current-to-*p*best/1/bin [4] using $F^{LSHA}{}_{i,G}$ and $CR^{LSHA}{}_{i,G}$;

35: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

36: $S^{LSHA}{}_{F} \leftarrow F^{LSHA}{}_{i,G}$, $S^{LSHA}{}_{CR} \leftarrow CR^{LSHA}{}_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $SC = SC + 1$;

37: **Else**

38: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 2$;

39: **End If**

40: **Else If** $IP_{i,G} = 2$

---------- For M_IDE Layer ----------

41: Set $o = i$ when Stage = eariler stage;

42: $r^{M\_IDE}{}_{i} = randint\left[1, H^{M\_IDE}\right]$, $F^{M\_IDE}{}_{i,G} = randc_i(M^{M\_IDE}{}_{F,r^{M\_IDE}{}_{i}}, 0.1)$, $CR^{M\_IDE}{}_{i,G} = randn_i(M^{M\_IDE}{}_{CR,r^{M\_IDE}{}_{i}}, 0.1)$;

43: Generate trial vector $\vec{u}_{i,G}$ via IDM mutation strategy (See **Procedure 2**) and classic crossover operation using $F^{M\_IDE}{}_{i,G}$ and $CR^{M\_IDE}{}_{i,G}$;

44: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

45: $S^{M\_IDE}{}_{F} \leftarrow F^{M\_IDE}{}_{i,G}$, $S^{M\_IDE}{}_{CR} \leftarrow CR^{M\_IDE}{}_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $SC = SC + 1$;

46: **Else**

47: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$, $IP_{i,G+1} = 1$;

48: **End If**

49: **End If**

50: **End If**

51: **End For**

52: **If** $NP_G > NP^{M\_IDE}$

53: **For** $i = NPT_G+1$: NP_G **Do** // These individuals only connect to the L-SHADE layer, as shown in Fig. S1.(b).

54: $r^{LSHA}{}_{i} = randint\left[1, H^{LSHA}\right]$, $F^{LSHA}{}_{i,G} = randc_i(M^{LSHA}{}_{F,r^{LSHA}{}_{i}}, 0.1)$, $CR^{LSHA}{}_{i,G} = randn_i(M^{LSHA}{}_{CR,r^{LSHA}{}_{i}}, 0.1)$;

55: Generate trial vector $\vec{u}_{i,G}$ via current-to-*p*best/1/bin [4] using $F^{LSHA}{}_{i,G}$ and $CR^{LSHA}{}_{i,G}$;

56: **If** $f(\vec{u}_{i,G}) \le f(\vec{x}_{i,G})$

57: $S^{LSHA}{}_{F} \leftarrow F^{LSHA}{}_{i,G}$, $S^{LSHA}{}_{CR} \leftarrow CR^{LSHA}{}_{i,G}$, $A \leftarrow \vec{x}_{i,G}$, $\vec{x}_{i,G+1} = \vec{u}_{i,G}$, $IP_{i,G+1} = IP_{i,G}$, $SC = SC + 1$;

58: **Else**

59: $\vec{x}_{i,G+1} = \vec{x}_{i,G}$;

60: **End If**

61: **End For**

62: **End If**

63: Update $M^{LSHA}{}_{F}$ and $M^{LSHA}{}_{CR}$ based on $S^{LSHA}{}_{F}$ and $S^{LSHA}{}_{CR}$, respectively (See **Procedure 3**); (For L-SHADE layer)

64: Update $M^{M\_IDE}{}_{F}$ and $M^{M\_IDE}{}_{CR}$ based on $S^{M\_IDE}{}_{F}$ and $S^{M\_IDE}{}_{CR}$, respectively (See **Procedure 3**); (For M_IDE layer)

65: Insert **Procedure 4** here. (For M_IDE layer)

66: Calculate NP_{G+1} based on the linear population size reduction (*LPSR*) scheme [4];

67: **If** $NP_G > NP_{G+1}$

68: Delete the worst $NP_G - NP_{G+1}$ individuals in term of fitness from P_G;

69: Discard the preferences of the deleted individuals;

70: **End If**

71: MAS_G = ceil(2.6×NP_G);

72: **If** $|A| > MAS_G$, randomly delete $|A| - MAS_G$ individuals from A; **End If**

73: $G = G + 1$;

74: $NPT_G = min(NP_G, NP^{M\_IDE})$;

75: **End While**

References

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[3] Y. Wang, H.-X. Li, T. Huang, L. Li, Differential evolution based on covariance matrix learning and bimodal distribution parameter setting, Appl. Soft Comput.18 (2014) 232–247.
[4] R. Tanabe , A.S. Fukunaga , Improving the search performance of SHADE using linear population size reduction, in: Evolutionary Computation (CEC), 2014 IEEE Congress on, IEEE, 2014, pp. 1658–1665 .

Part II
Experiment Results

TABLE CAPTIONS

TABLE S1 PARAMETER SETTINGS FOR NINE DE VARIANTS

TABLE S2 PERFORMANCE COMPARISONS OF NINE STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S3 COMPARISON RESULTS OF THE NINE DE VARIANTS WITH EACH OTHER ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

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TABLE S8 PERFORMANCE COMPARISONS OF VARIANT-IV OF MLCC-SI WITH SHADE AND IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

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TABLE S14 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S15 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 30-DIMENSIONAL CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S16 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 50-DIMENSIONAL CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S17 PERFORMANCE COMPARISONS OF MLCC-SIBI WITH SHADE, IDE AND BIDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S18 PERFORMANCE COMPARISONS OF MLCC-L-SI WITH L-SHADE AND M_IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

TABLE S1 PARAMETER SETTINGS FOR NINE DE VARIANTS

Algorithm	Parameter Settings
jDE	γ_1= 0.1, γ_2 = 0.1, F_l = 0.1, F_u = 0.9 and NP = 100;
SaDE	LP = 50, NP = 50;
EPSDE	$F\in$[0.4, 0.5, 0.6, 0.7, 0.8, 0.9], $CR\in$[0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9] and NP = 50;
JADE	p = 0.05, c = 0.1, μ_F = 0.7, μ_{CR} = 0.5 and NP = 100;
CoDE	[F = 1.0, Cr = 0.1]; [F = 1.0, Cr = 0.9]; [F = 0.8, Cr = 0.2] and NP = 30;
CoBiDE	pb = 0.4, ps = 0.5 and NP = 60;
MPEDE	$\lambda_1 = \lambda_2 = \lambda_3$ = 0.2, ng = 20 and NP = 250;
SHADE	NP = 100, M_F = {0.7}, M_{CR} = {0.5} and H = NP
IDE	NP = 100, T = 1000D/NP, G_T = 5T, SR_T = 0 ($G < G_T$) and SR_T = 0.1 ($G \geq G_T$)

TABLE S2 PERFORMANCE COMPARISONS OF NINE STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	MPEDE	SHADE	IDE	SHADE v.s. IDE
F1	5.86E+04 (4.66E+04)	6.85E+04 (5.67E+04)	1.51E+04 (3.18E+04)	1.75E+03 (2.27E+03)	2.33E+04 (1.76E+04)	1.97E+04 (1.43E+04)	**0.00E+00** (0.00E+00)	2.30E+03 (3.04E+03)	1.04E+05 (9.74E+04)	+
F2	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	=
F3	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	4.51E-04 (3.18E-03)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	=
F4	5.19E+00 (1.45E+01)	2.03E+00 (9.06E+00)	3.45E+00 (1.78E+00)	1.24E+00 (8.88E+00)	5.06E+00 (1.75E+01)	8.64E-02 (5.58E-01)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	2.97E-03 (1.52E-02)	+
F5	2.04E+01 (3.53E-02)	2.09E+01 (6.14E-02)	2.03E+01 (4.05E-02)	2.03E+01 (3.68E-02)	**2.00E+01** (7.07E-02)	2.02E+01 (2.74E-01)	2.04E+01 (4.94E-02)	2.02E+01 (2.72E-02)	2.02E+01 (5.16E-02)	=
F6	1.52E+00 (2.87E+00)	2.29E+00 (1.43E+00)	1.89E+01 (1.36E+00)	8.64E+00 (2.49E+00)	2.33E+00 (1.63E+00)	1.28E+00 (1.27E+00)	4.82E-01 (6.52E-01)	4.81E-01 (1.11E+00)	**2.97E-02** (2.10E-01)	-
F7	**0.00E+00** (0.00E+00)	4.77E-03 (9.01E-03)	1.21E-03 (4.21E-03)	3.87E-04 (1.99E-03)	4.35E-04 (2.19E-03)	3.38E-04 (1.71E-03)	7.25E-04 (2.53E-03)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	=
F8	**0.00E+00** (0.00E+00)	3.00E+00 (1.71E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** (0.00E+00)	5.41E-03 (3.86E-02)	=
F9	4.25E+01 (6.27E+00)	2.90E+01 (8.26E+00)	4.29E+01 (6.90E+00)	2.64E+01 (4.51E+00)	4.01E+01 (1.06E+01)	4.02E+01 (1.06E+01)	2.89E+01 (8.20E+00)	**1.86E+01** (2.88E+00)	2.60E+01 (4.92E+00)	+
F10	**1.63E-03** (5.65E-03)	3.71E+01 (3.14E+01)	2.22E-01 (1.93E-01)	7.76E-03 (1.17E-02)	4.75E-01 (6.22E-01)	3.23E+01 (1.26E+01)	1.13E+00 (5.33E-01)	6.12E-03 (1.12E-02)	5.25E+00 (1.76E+01)	+
F11	2.51E+03 (2.57E+02)	5.15E+03 (4.53E+02)	3.60E+03 (4.26E+02)	1.65E+03 (2.45E+02)	1.80E+03 (4.99E+02)	1.81E+03 (5.37E+02)	2.35E+03 (4.57E+02)	**1.59E+03** (2.04E+02)	1.96E+03 (3.92E+02)	+
F12	4.76E-01 (6.04E-02)	1.74E+00 (2.32E-01)	5.13E-01 (4.94E-02)	2.57E-01 (4.16E-02)	**7.03E-02** (5.33E-02)	1.46E-01 (2.35E-01)	4.88E-01 (1.03E-01)	2.02E-01 (2.62E-02)	2.68E-01 (7.49E-02)	+
F13	2.89E-01 (4.08E-02)	2.51E-01 (3.69E-02)	2.52E-01 (4.03E-02)	2.08E-01 (3.02E-02)	2.35E-01 (5.12E-02)	2.28E-01 (5.14E-02)	2.16E-01 (3.16E-02)	1.92E-01 (2.60E-02)	**1.81E-01** (2.46E-02)	-
F14	2.74E-01 (3.00E-02)	2.48E-01 (3.10E-02)	2.72E-01 (5.76E-02)	2.24E-01 (3.19E-02)	2.39E-01 (3.25E-02)	2.31E-01 (4.01E-02)	2.42E-01 (2.92E-02)	2.00E-01 (3.78E-02)	**1.91E-01** (2.65E-02)	=
F15	5.80E+00 (6.09E-01)	5.63E+00 (2.63E+00)	5.45E+00 (6.87E-01)	3.21E+00 (4.09E-01)	3.00E+00 (7.92E-01)	3.19E+00 (7.73E-01)	3.97E+00 (7.66E-01)	2.89E+00 (3.49E-01)	**2.61E+00** (5.29E-01)	-
F16	9.79E+00 (3.06E-01)	1.17E+01 (3.44E-01)	1.12E+01 (3.87E-01)	9.47E+00 (3.44E-01)	**9.08E+00** (7.92E-01)	9.41E+00 (9.66E-01)	1.01E+01 (3.73E-01)	9.53E+00 (3.36E-01)	9.82E+00 (5.54E-01)	+
F17	1.68E+03 (2.20E+03)	3.89E+03 (2.19E+03)	3.42E+04 (3.51E+04)	1.08E+03 (3.52E+02)	1.81E+03 (2.14E+03)	3.19E+02 (1.85E+02)	**2.50E+02** (1.66E+02)	1.04E+03 (3.69E+02)	7.50E+02 (2.38E+02)	-
F18	1.72E+01 (7.16E+00)	2.46E+02 (3.44E+02)	3.38E+02 (8.34E+02)	1.45E+02 (3.59E+02)	**1.23E+01** (4.70E+00)	1.33E+01 (5.92E+00)	1.24E+01 (4.96E+00)	4.09E+01 (1.80E+01)	1.52E+01 (4.85E+00)	-
F19	4.46E+00 (6.07E-01)	5.89E+00 (8.30E+00)	1.31E+01 (1.27E+00)	4.52E+00 (6.92E-01)	**2.75E+00** (8.15E-01)	2.91E+00 (3.36E-01)	3.92E+00 (6.47E-01)	4.43E+00 (5.68E-01)	3.07E+00 (5.56E-01)	-
F20	1.08E+01 (3.70E+00)	7.25E+01 (4.04E+01)	1.14E+02 (2.09E+02)	3.01E+03 (3.06E+03)	1.25E+01 (5.15E+00)	**8.61E+00** (3.22E+00)	9.43E+00 (3.35E+00)	1.06E+01 (5.52E+00)	9.88E+00 (2.65E+00)	=
F21	2.65E+02 (1.67E+02)	1.07E+03 (9.00E+02)	1.00E+04 (1.66E+04)	1.39E+03 (7.71E+03)	1.96E+02 (1.43E+02)	1.58E+02 (1.22E+02)	**8.76E+01** (9.29E+01)	2.53E+02 (1.18E+02)	2.52E+02 (1.30E+02)	=
F22	1.15E+02 (5.38E+01)	9.89E+01 (6.66E+01)	2.50E+02 (1.02E+02)	1.32E+02 (7.40E+01)	1.79E+02 (9.78E+01)	1.09E+02 (8.74E+01)	5.90E+01 (5.14E+01)	8.91E+01 (5.86E+01)	**5.82E+01** (5.30E+01)	-
F23	3.15E+02 (4.02E-13)	3.15E+02 (4.02E-13)	**3.14E+02** (1.03E-12)	3.15E+02 (4.02E-13)	3.15E+02 (3.73E-13)	3.15E+02 (4.02E-13)	3.15E+02 (4.02E-13)	3.15E+02 (4.02E-13)	3.15E+02 (3.46E-13)	-
F24	2.24E+02 (2.24E+00)	2.26E+02 (3.59E+00)	2.30E+02 (5.88E+00)	2.24E+02 (1.69E+00)	2.24E+02 (3.21E+00)	**2.23E+02** (9.99E-01)	2.24E+02 (8.99E-01)	2.24E+02 (9.48E-01)	2.24E+02 (7.19E-01)	-
F25	2.03E+02 (5.18E-01)	2.08E+02 (2.69E+00)	**2.00E+02** (3.44E-01)	2.05E+02 (2.05E+00)	2.03E+02 (6.07E-01)	2.03E+02 (4.36E-01)	2.03E+02 (3.38E-01)	2.06E+02 (1.88E+00)	2.03E+02 (1.24E-01)	-
F26	**1.00E+02** (3.75E-02)	**1.00E+02** (3.31E-02)	**1.00E+02** (4.52E-02)	**1.00E+02** (3.38E-02)	**1.00E+02** (5.47E-02)	**1.00E+02** (5.41E-02)	**1.00E+02** (2.81E-02)	**1.00E+02** (3.52E-02)	**1.00E+02** (2.92E-02)	-
F27	3.48E+02 (5.03E+01)	3.72E+02 (3.89E+01)	8.73E+02 (3.67E+01)	3.68E+02 (4.92E+01)	3.69E+02 (4.44E+01)	3.89E+02 (3.28E+01)	3.66E+02 (4.73E+01)	**3.31E+02** (4.58E+01)	3.69E+02 (4.72E+01)	+
F28	7.89E+02 (2.34E+01)	8.69E+02 (3.67E+01)	**3.96E+02** (1.34E+01)	8.00E+02 (1.89E+01)	8.36E+02 (2.62E+01)	8.28E+02 (2.82E+01)	8.37E+02 (3.53E+01)	8.03E+02 (2.38E+01)	8.08E+02 (1.32E+02)	+
F29	7.95E+02 (6.99E+01)	9.13E+02 (2.04E+02)	**2.14E+02** (1.46E+00)	7.18E+02 (6.90E+01)	7.68E+02 (1.43E+02)	5.27E+02 (2.62E+02)	6.88E+02 (1.24E+02)	7.22E+02 (2.67E+01)	2.91E+02 (1.49E+02)	-
F30	1.20E+03 (4.47E+02)	1.86E+03 (5.78E+02)	5.99E+02 (1.46E+02)	1.56E+03 (5.17E+02)	9.35E+02 (4.22E+02)	7.29E+02 (2.83E+02)	6.37E+02 (1.99E+02)	1.24E+03 (3.38E+02)	**5.22E+02** (7.29E+01)	-
Ranking	5.76	7.53	6.38	5.15	4.86	4.06	4.21	**3.48**	3.53	

Note: "-", "=" and "+" at last column represent that the performance of SHADE is significantly worse than, similar to or better than that of IDE, respectively.

TABLE S3 COMPARISON RESULTS OF THE NINE DE VARIANTS WITH EACH OTHER ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

-/=/+	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	MPEDE	SHADE	IDE
jDE	---	18/6/6	15/5/10	8/10/12	5/11/14	3/10/17	4/11/15	4/13/13	3/10/17
SaDE	6/6/18	---	10/6/14	3/6/21	2/6/22	1/6/23	0/6/24	0/5/25	1/4/25
EPSDE	10/5/15	14/6/10	---	6/4/20	7/6/17	7/6/17	6/6/18	5/3/22	6/3/21
JADE	12/10/8	21/6/3	20/4/6	---	9/9/12	6/12/12	8/10/12	1/15/14	6/6/18
CoDE	14/11/5	22/6/2	17/6/7	12/9/9	---	1/21/8	7/10/13	8/8/14	9/9/12
CoBiDE	17/10/3	23/6/1	17/6/7	12/12/6	8/21/1	---	7/13/10	9/9/12	9/8/13
MPEDE	15/11/4	24/6/0	18/6/6	12/10/8	13/10/7	10/13/7	---	9/7/14	7/7/16
SHADE	13/13/4	25/5/0	22/3/5	14/15/1	14/8/8	12/9/9	14/7/9	---	9/8/13
IDE	17/10/3	25/4/1	21/3/6	18/6/6	12/9/9	13/8/9	16/7/7	13/8/9	---

Note: "-", "=" and "+" represent the number of functions that algorithms in row win, tie and lose to algorithms in column according to Wilcoxon's signed-rank test with a significance level of 0.05, respectively.

TABLE S4 PERFORMANCE COMPARISONS OF MLCC-SI WITH ITS VARIANTS ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30					*D* = 50				
	Variant-I	Variant-II	Variant-III	Variant-IV	MLCC-SI	Variant-I	Variant-II	Variant-III	Variant-IV	MLCC-SI
F1	6.00E+03 = (6.81E+03)	**9.15E+02** + (2.06E+03)	1.24E+03 + (2.86E+03)	3.49E+03 = (3.73E+03)	4.76E+03 (5.69E+03)	2.97E+05 = (1.01E+05)	**1.07E+05** + (4.11E+04)	1.15E+05 + (5.07E+04)	2.42E+05 = (8.92E+04)	2.79E+05 (1.00E+05)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	4.49E-04 - (5.00E-04)	**0.00E+00** + (0.00E+00)	**0.00E+00** + (0.00E+00)	1.07E-04 + (1.41E-04)	2.67E-04 (3.59E-04)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	2.22E-09 = (8.73E-09)	**0.00E+00** = (0.00E+00)	6.86E-01 = (4.90E+00)	4.25E-01 = (3.03E+00)	2.10E-10 (1.50E-09)
F4	2.40E-07 = (6.38E-07)	**0.00E+00** + (0.00E+00)	**0.00E+00** + (0.00E+00)	6.03E-07 = (2.29E-06)	1.63E-07 (4.37E-07)	6.60E+01 = (2.76E+01)	8.05E+01 - (1.29E+01)	8.27E+01 - (6.01E+00)	7.00E+01 - (2.53E+01)	**6.53E+01** (2.62E+01)
F5	2.04E+01 - (5.22E-02)	**2.02E+01** = (4.90E-02)	2.03E+01 - (5.46E-02)	2.04E+01 - (4.56E-02)	**2.02E+01** (5.40E-02)	2.06E+01 - (4.58E-02)	**2.03E+01** = (5.22E-02)	2.05E+01 - (5.56E-02)	2.06E+01 - (4.04E-02)	**2.03E+01** (5.46E-02)
F6	1.68E-01 = (6.60E-01)	9.31E-01 - (1.45E+00)	1.11E+00 - (1.25E+00)	**2.69E-02** = (9.09E-02)	8.71E-02 (2.84E-01)	**1.47E-01** + (1.98E-01)	5.57E-01 = (6.31E-01)	3.76E-01 = (5.11E-01)	2.06E-01 + (3.89E-01)	3.96E-01 (5.61E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	4.55E-07 - (2.62E-06)	3.97E+00 - (1.28E+00)	9.25E+00 - (1.43E+00)	1.33E-07 - (2.57E-07)	**0.00E+00** (0.00E+00)
F9	**2.01E+01** = (3.57E+00)	2.17E+01 = (4.71E+00)	2.13E+01 = (4.56E+00)	2.03E+01 = (4.26E+00)	2.14E+01 (4.44E+00)	**4.25E+01** = (8.50E+00)	5.48E+01 - (1.12E+01)	5.25E+01 - (1.22E+01)	4.36E+01 = (8.45E+00)	4.47E+01 (8.15E+00)
F10	2.24E+00 - (1.37E+00)	2.59E+00 - (1.22E+00)	6.05E+00 - (2.83E+00)	2.56E+00 - (1.73E+00)	**1.12E+00** (9.49E-01)	1.57E+01 - (7.26E+00)	2.54E+01 - (1.44E+01)	6.28E+01 - (2.43E+01)	1.81E+01 - (9.40E+00)	**9.00E+00** (3.38E+00)
F11	1.81E+03 - (3.30E+02)	1.72E+03 = (2.92E+02)	1.79E+03 - (3.84E+02)	1.70E+03 = (3.59E+02)	**1.63E+03** (3.34E+02)	3.93E+03 = (6.24E+02)	4.77E+03 - (3.91E+02)	5.31E+03 - (5.31E+02)	**3.92E+03** = (6.72E+02)	4.03E+03 (5.06E+02)
F12	4.01E-01 - (6.09E-02)	**2.57E-01** = (5.68E-02)	3.12E-01 - (5.74E-02)	3.84E-01 - (7.25E-02)	2.60E-01 (5.31E-02)	5.66E-01 - (8.17E-02)	**3.39E-01** = (5.05E-02)	4.60E-01 - (5.81E-02)	5.93E-01 - (6.83E-02)	3.51E-01 (5.92E-02)
F13	1.98E-01 - (2.46E-02)	1.91E-01 = (2.54E-02)	**1.83E-01** = (2.64E-02)	1.98E-01 - (2.03E-02)	**1.83E-01** (2.79E-02)	2.84E-01 = (3.84E-02)	**2.77E-01** = (2.97E-02)	2.84E-01 = (2.77E-02)	2.84E-01 = (2.73E-02)	**2.77E-01** (2.58E-02)
F14	2.05E-01 - (2.82E-02)	**1.94E-01** = (2.31E-02)	1.97E-01 = (2.49E-02)	2.00E-01 = (2.48E-02)	**1.94E-01** (2.21E-02)	2.71E-01 - (1.90E-02)	**2.51E-01** = (2.37E-02)	2.60E-01 = (2.12E-02)	2.63E-01 = (2.32E-02)	2.56E-01 (2.36E-02)
F15	2.61E+00 = (5.61E-01)	3.11E+00 - (4.82E-01)	3.53E+00 - (4.93E-01)	2.63E+00 = (4.98E-01)	**2.47E+00** (4.20E-01)	6.97E+00 = (2.05E+00)	9.39E+00 - (1.13E+00)	1.09E+01 - (1.19E+00)	7.29E+00 - (1.95E+00)	**6.41E+00** (1.34E+00)
F16	9.77E+00 - (4.84E-01)	9.58E+00 = (4.87E-01)	9.81E+00 - (3.51E-01)	9.79E+00 - (3.48E-01)	**9.52E+00** (4.66E-01)	1.89E+01 - (5.07E-01)	**1.84E+01** = (4.92E-01)	1.89E+01 - (3.48E-01)	1.89E+01 - (3.95E-01)	1.85E+01 (4.53E-01)
F17	2.44E+02 = (1.38E+02)	4.05E+02 - (2.24E+02)	4.73E+02 - (2.35E+02)	2.56E+02 = (1.43E+02)	**2.31E+02** (1.23E+02)	1.36E+03 = (3.48E+02)	1.77E+03 - (4.83E+02)	1.79E+03 - (4.48E+02)	**1.26E+03** = (4.55E+02)	1.27E+03 (4.01E+02)
F18	**9.13E+00** = (3.63E+00)	1.34E+01 - (5.17E+00)	1.25E+01 - (4.86E+00)	9.36E+00 = (3.28E+00)	9.79E+00 (3.36E+00)	3.07E+01 = (8.48E+00)	4.77E+01 - (1.59E+01)	4.84E+01 - (1.29E+01)	**2.93E+01** + (9.31E+00)	3.55E+01 (1.17E+01)
F19	3.05E+00 = (4.93E-01)	3.33E+00 - (5.27E-01)	3.55E+00 - (3.97E-01)	3.06E+00 = (4.65E-01)	**3.02E+00** (5.37E-01)	9.92E+00 = (4.59E-01)	1.07E+01 - (3.00E+00)	1.11E+01 - (3.11E+00)	1.00E+01 = (4.58E-01)	**9.87E+00** (3.98E-01)
F20	**5.30E+00** + (1.96E+00)	6.86E+00 = (2.74E+00)	6.05E+00 = (2.00E+00)	5.72E+00 = (1.76E+00)	5.91E+00 (1.42E+00)	2.54E+01 = (6.27E+00)	4.15E+01 - (1.47E+01)	3.98E+01 - (1.35E+01)	2.56E+01 = (6.76E+00)	**2.53E+01** (6.78E+00)
F21	**1.03E+02** = (7.42E+01)	1.18E+02 = (8.81E+01)	1.40E+02 - (6.83E+01)	1.09E+02 = (6.86E+01)	1.04E+02 (7.65E+01)	6.19E+02 = (2.05E+02)	6.43E+02 - (2.25E+02)	6.57E+02 - (2.10E+02)	5.62E+02 = (1.86E+02)	**5.42E+02** (1.92E+02)
F22	5.10E+01 = (4.81E+01)	7.30E+01 - (5.79E+01)	5.15E+01 - (4.37E+01)	5.74E+01 - (5.13E+01)	**3.55E+01** (3.45E+01)	2.94E+02 = (1.17E+02)	**2.65E+02** = (1.09E+02)	2.70E+02 = (1.03E+02)	2.76E+02 = (1.08E+02)	2.75E+02 (1.13E+02)
F23	**3.15E+02** = (3.59E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.32E-13)	**3.44E+02** = (4.39E-13)	**3.44E+02** = (4.67E-13)	**3.44E+02** = (4.25E-13)	**3.44E+02** (4.18E-13)
F24	**2.23E+02** = (7.73E-01)	**2.23E+02** = (8.31E-01)	**2.23E+02** = (7.26E-01)	**2.23E+02** = (7.66E-01)	**2.23E+02** (7.91E-01)	**2.58E+02** = (1.59E+00)	**2.58E+02** = (2.96E+00)	2.59E+02 = (3.67E+00)	**2.58E+02** = (1.55E+00)	**2.58E+02** (2.93E+00)
F25	**2.03E+02** = (2.73E-01)	**2.03E+02** = (4.01E-01)	**2.03E+02** = (4.66E-01)	**2.03E+02** = (2.87E-01)	**2.03E+02** (2.95E-01)	**2.06E+02** = (8.37E-01)	2.07E+02 - (1.35E+00)	2.07E+02 - (1.36E+00)	**2.06E+02** = (6.65E-01)	**2.06E+02** (8.22E-01)
F26	**1.00E+02** = (2.48E-02)	**1.00E+02** = (2.17E-02)	**1.00E+02** = (2.64E-02)	**1.00E+02** = (2.70E-02)	**1.00E+02** (2.41E-02)	1.02E+02 = (1.40E+01)	1.02E+02 = (1.40E+01)	**1.00E+02** = (2.49E-02)	1.02E+02 = (1.40E+01)	**1.00E+02** (2.83E-02)
F27	3.32E+02 = (4.71E+01)	3.10E+02 + (3.01E+01)	3.30E+02 = (4.62E+01)	**3.08E+02** + (2.72E+01)	3.47E+02 (5.07E+01)	3.23E+02 = (2.65E+01)	3.16E+02 = (2.46E+01)	3.14E+02 = (2.39E+01)	**3.13E+02** = (2.17E+01)	3.20E+02 (2.65E+01)
F28	7.95E+02 - (3.07E+01)	8.09E+02 - (2.06E+01)	8.05E+02 - (2.83E+01)	7.97E+02 - (2.09E+01)	**7.89E+02** (3.09E+01)	**1.13E+03** + (4.90E+01)	1.18E+03 - (4.54E+01)	1.16E+03 = (3.82E+01)	**1.13E+03** + (3.19E+01)	1.16E+03 (3.60E+01)
F29	6.73E+02 = (1.54E+02)	6.75E+02 = (1.49E+02)	**6.36E+02** + (1.92E+02)	6.64E+02 + (1.69E+02)	6.94E+02 (1.27E+02)	6.17E+02 = (1.36E+02)	6.01E+02 = (7.52E+01)	**5.84E+02** = (8.30E+01)	6.15E+02 = (1.09E+02)	6.22E+02 (1.41E+02)
F30	**4.96E+02** = (8.28E+01)	5.01E+02 = (8.89E+01)	5.36E+02 = (1.53E+02)	5.15E+02 = (1.12E+02)	5.20E+02 (1.60E+02)	8.67E+03 = (4.42E+02)	8.73E+03 = (5.24E+02)	8.82E+03 - (4.19E+02)	8.67E+03 = (4.38E+02)	**8.61E+03** (3.99E+02)
-/=/+	**8/21/1**	**8/19/3**	**13/14/3**	**7/21/2**		**7/21/2**	**13/15/2**	**16/12/2**	**7/19/4**	

TABLE S5 PERFORMANCE COMPARISONS OF VARIANT-I OF MLCC-SI WITH SHADE AND IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			D = 50		
	SHADE	IDE	Variant-I	SHADE	IDE	Variant-I
F1	**2.59E+02** + (5.67E+02)	1.18E+05 - (9.41E+04)	6.00E+03 (6.81E+03)	**1.19E+05** + (6.14E+04)	1.24E+06 - (3.41E+05)	2.97E+05 (1.01E+05)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** + (0.00E+00)	2.28E+00 - (2.53E+00)	4.49E-04 (5.00E-04)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** + (0.00E+00)	1.85E+01 - (1.27E+01)	2.22E-09 (8.73E-09)
F4	**0.00E+00** + (0.00E+00)	2.08E-02 - (4.14E-02)	2.40E-07 (6.38E-07)	8.35E+01 = (1.16E+01)	7.19E+01 - (2.97E+01)	**6.60E+01** (2.76E+01)
F5	2.03E+01 + (3.54E-02)	**2.02E+01** + (5.68E-02)	2.04E+01 (5.22E-02)	2.05E+01 + (4.03E-02)	**2.03E+01** + (5.95E-02)	2.06E+01 (4.58E-02)
F6	6.41E+00 - (3.86E+00)	**6.20E-02** = (2.82E-01)	1.68E-01 (6.60E-01)	1.18E+00 - (3.45E+00)	**9.34E-02** + (3.14E-01)	1.47E-01 (1.98E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.22E-03 - (4.10E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	4.33E-10 = (3.09E-09)	**0.00E+00** (0.00E+00)	1.84E-02 - (5.39E-03)	4.32E-02 - (1.97E-01)	**4.55E-07** (2.62E-06)
F9	2.75E+01 - (4.18E+00)	2.46E+01 - (5.33E+00)	**2.01E+01** (3.57E+00)	8.82E+01 - (8.25E+00)	5.99E+01 - (1.01E+01)	**4.25E+01** (8.50E+00)
F10	**1.57E-01** + (3.94E-02)	5.68E+00 - (1.66E+01)	2.24E+00 (1.37E+00)	6.06E+01 - (6.43E+00)	3.34E+01 + (4.90E+01)	**1.57E+01** (7.26E+00)
F11	1.97E+03 - (2.06E+02)	1.92E+03 = (3.53E+02)	**1.81E+03** (3.30E+02)	6.27E+03 - (3.93E+02)	4.20E+03 - (6.65E+02)	**3.93E+03** (6.24E+02)
F12	3.08E-01 + (4.82E-02)	**2.91E-01** + (5.97E-02)	4.01E-01 (6.09E-02)	6.12E-01 - (6.73E-02)	**3.68E-01** + (7.37E-02)	5.66E-01 (8.17E-02)
F13	2.15E-01 - (2.58E-02)	**1.87E-01** + (2.20E-02)	1.98E-01 (2.46E-02)	3.01E-01 - (2.99E-02)	2.96E-01 = (3.09E-02)	**2.84E-01** (3.84E-02)
F14	2.14E-01 = (2.24E-02)	**1.82E-01** + (3.19E-02)	2.05E-01 (2.82E-02)	**2.50E-01** + (1.82E-02)	2.70E-01 = (2.23E-02)	2.71E-01 (1.90E-02)
F15	3.83E+00 - (4.70E-01)	2.69E+00 = (5.27E-01)	**2.61E+00** (5.61E-01)	1.18E+01 - (8.02E-01)	7.36E+00 = (1.93E+00)	**6.97E+00** (2.05E+00)
F16	**9.55E+00** + (3.49E-01)	1.00E+01 - (3.94E-01)	9.77E+00 (4.84E-01)	**1.88E+01** = (2.77E-01)	1.92E+01 - (4.21E-01)	1.89E+01 (5.07E-01)
F17	7.62E+02 - (3.58E+02)	5.97E+02 - (2.97E+02)	**2.44E+02** (1.38E+02)	2.21E+03 - (5.57E+02)	7.22E+03 - (2.74E+03)	**1.36E+03** (3.48E+02)
F18	1.44E+01 - (7.28E+00)	1.90E+01 - (5.87E+00)	**9.13E+00** (3.63E+00)	8.03E+01 - (2.31E+01)	3.93E+01 - (1.09E+01)	**3.07E+01** (8.48E+00)
F19	4.01E+00 - (6.47E-01)	**2.91E+00** = (4.69E-01)	3.05E+00 (4.93E-01)	1.29E+01 - (5.85E+00)	1.03E+01 - (7.50E-01)	**9.92E+00** (4.59E-01)
F20	**4.96E+00** = (2.19E+00)	1.08E+01 - (3.24E+00)	5.30E+00 (1.96E+00)	4.11E+01 - (1.63E+01)	4.54E+01 - (1.04E+01)	**2.54E+01** (6.27E+00)
F21	1.29E+02 = (8.62E+01)	3.30E+02 - (1.54E+02)	**1.03E+02** (7.42E+01)	9.75E+02 - (2.81E+02)	1.23E+03 - (3.77E+02)	**6.19E+02** (2.05E+02)
F22	1.23E+02 - (5.85E+01)	7.30E+01 = (5.78E+01)	**5.10E+01** (4.81E+01)	4.85E+02 - (1.22E+02)	3.04E+02 = (1.06E+02)	**2.94E+02** (1.17E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** = (3.46E-13)	**3.15E+02** (3.59E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** = (4.46E-13)	**3.44E+02** (4.32E-13)
F24	**2.23E+02** = (9.22E-01)	**2.23E+02** - (7.24E-01)	**2.23E+02** (7.73E-01)	2.69E+02 - (1.90E+00)	**2.58E+02** + (3.39E+00)	**2.58E+02** (1.59E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** - (2.33E-01)	**2.03E+02** (2.73E-01)	2.11E+02 - (2.59E+00)	2.07E+02 - (6.05E-01)	**2.06E+02** (8.37E-01)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (2.60E-02)	**1.00E+02** (2.48E-02)	**1.00E+02** - (3.37E-02)	1.06E+02 = (2.37E+01)	1.02E+02 (1.40E+01)
F27	**3.00E+02** + (1.11E-13)	3.30E+02 = (4.63E+01)	3.32E+02 (4.71E+01)	3.33E+02 = (2.79E+01)	**3.06E+02** + (1.65E+01)	3.23E+02 (2.65E+01)
F28	**7.92E+02** = (1.86E+01)	8.26E+02 - (8.10E+01)	7.95E+02 (3.07E+01)	**1.09E+03** + (3.20E+01)	1.28E+03 - (9.49E+01)	1.13E+03 (4.90E+01)
F29	7.20E+02 = (6.01E+00)	**5.75E+02** = (2.15E+02)	6.73E+02 (1.54E+02)	8.27E+02 - (5.63E+01)	1.03E+03 - (1.26E+02)	**6.17E+02** (1.36E+02)
F30	1.22E+03 - (4.61E+02)	5.18E+02 - (7.28E+01)	**4.96E+02** (8.28E+01)	**8.45E+03** + (4.59E+02)	9.90E+03 - (5.82E+02)	8.67E+03 (4.42E+02)
-/=/+	**12/11/7**	**13/13/4**		**18/5/7**	**18/6/6**	

TABLE S6 PERFORMANCE COMPARISONS OF VARIANT-II OF MLCC-SI WITH SHADE AND IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			D = 50		
	SHADE	IDE	Variant-II	SHADE	IDE	Variant-II
F1	**2.59E+02** + (5.67E+02)	1.18E+05 - (9.41E+04)	9.15E+02 (2.06E+03)	1.19E+05 = (6.14E+04)	1.24E+06 - (3.41E+05)	**1.07E+05** (4.11E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.28E+00 - (2.53E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	1.85E+01 - (1.27E+01)	**0.00E+00** (0.00E+00)
F4	**0.00E+00** = (0.00E+00)	2.08E-02 - (4.14E-02)	**0.00E+00** (0.00E+00)	8.35E+01 + (1.16E+01)	**7.19E+01** = (2.97E+01)	8.05E+01 (1.29E+01)
F5	2.03E+01 - (3.54E-02)	**2.02E+01** = (5.68E-02)	**2.02E+01** (4.90E-02)	2.05E+01 - (4.03E-02)	**2.03E+01** - (5.95E-02)	**2.03E+01** (5.22E-02)
F6	6.41E+00 - (3.86E+00)	**6.20E-02** + (2.82E-01)	9.31E-01 (1.45E+00)	1.18E+00 = (3.45E+00)	**9.34E-02** + (3.14E-01)	5.57E-01 (6.31E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.22E-03 - (4.10E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	4.33E-10 = (3.09E-09)	**0.00E+00** (0.00E+00)	**1.84E-02** + (5.39E-03)	4.32E-02 + (1.97E-01)	3.97E+00 (1.28E+00)
F9	2.75E+01 - (4.18E+00)	2.46E+01 - (5.33E+00)	**2.17E+01** (4.71E+00)	8.82E+01 - (8.25E+00)	5.99E+01 - (1.01E+01)	**5.48E+01** (1.12E+01)
F10	**1.57E-01** + (3.94E-02)	5.68E+00 - (1.66E+01)	2.59E+00 (1.22E+00)	6.06E+01 - (6.43E+00)	3.34E+01 + (4.90E+01)	**2.54E+01** (1.44E+01)
F11	1.97E+03 - (2.06E+02)	1.92E+03 - (3.53E+02)	**1.72E+03** (2.92E+02)	6.27E+03 - (3.93E+02)	**4.20E+03** + (6.65E+02)	4.77E+03 (3.91E+02)
F12	3.08E-01 - (4.82E-02)	2.91E-01 - (5.97E-02)	**2.57E-01** (5.68E-02)	6.12E-01 - (6.73E-02)	3.68E-01 = (7.37E-02)	**3.39E-01** (5.05E-02)
F13	2.15E-01 - (2.58E-02)	**1.87E-01** = (2.20E-02)	1.91E-01 (2.54E-02)	3.01E-01 - (2.99E-02)	2.96E-01 - (3.09E-02)	**2.77E-01** (2.97E-02)
F14	2.14E-01 - (2.24E-02)	**1.82E-01** = (3.19E-02)	1.94E-01 (2.31E-02)	**2.50E-01** = (1.82E-02)	2.70E-01 - (2.23E-02)	2.51E-01 (2.37E-02)
F15	3.83E+00 - (4.70E-01)	**2.69E+00** + (5.27E-01)	3.11E+00 (4.82E-01)	1.18E+01 - (8.02E-01)	**7.36E+00** + (1.93E+00)	9.39E+00 (1.13E+00)
F16	**9.55E+00** = (3.49E-01)	1.00E+01 - (3.94E-01)	9.58E+00 (4.87E-01)	1.88E+01 - (2.77E-01)	1.92E+01 - (4.21E-01)	**1.84E+01** (4.92E-01)
F17	7.62E+02 - (3.58E+02)	5.97E+02 - (2.97E+02)	**4.05E+02** (2.24E+02)	2.21E+03 - (5.57E+02)	7.22E+03 - (2.74E+03)	**1.77E+03** (4.83E+02)
F18	1.44E+01 = (7.28E+00)	1.90E+01 - (5.87E+00)	**1.34E+01** (5.17E+00)	8.03E+01 - (2.31E+01)	**3.93E+01** + (1.09E+01)	4.77E+01 (1.59E+01)
F19	4.01E+00 - (6.47E-01)	**2.91E+00** + (4.69E-01)	3.33E+00 (5.27E-01)	1.29E+01 - (5.85E+00)	**1.03E+01** = (7.50E-01)	1.07E+01 (3.00E+00)
F20	**4.96E+00** + (2.19E+00)	1.08E+01 - (3.24E+00)	6.86E+00 (2.74E+00)	**4.11E+01** = (1.63E+01)	4.54E+01 - (1.04E+01)	4.15E+01 (1.47E+01)
F21	1.29E+02 = (8.62E+01)	3.30E+02 - (1.54E+02)	**1.18E+02** (8.81E+01)	9.75E+02 - (2.81E+02)	1.23E+03 - (3.77E+02)	**6.43E+02** (2.25E+02)
F22	1.23E+02 - (5.85E+01)	**7.30E+01** = (5.78E+01)	**7.30E+01** (5.79E+01)	4.85E+02 - (1.22E+02)	3.04E+02 = (1.06E+02)	**2.65E+02** (1.09E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** + (3.46E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** = (4.46E-13)	**3.44E+02** (4.39E-13)
F24	**2.23E+02** = (9.22E-01)	**2.23E+02** = (7.24E-01)	**2.23E+02** (8.31E-01)	2.69E+02 - (1.90E+00)	**2.58E+02** = (3.39E+00)	**2.58E+02** (2.96E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** = (2.33E-01)	**2.03E+02** (4.01E-01)	2.11E+02 - (2.59E+00)	**2.07E+02** = (6.05E-01)	**2.07E+02** (1.35E+00)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (2.60E-02)	**1.00E+02** (2.17E-02)	**1.00E+02** - (3.37E-02)	1.06E+02 = (2.37E+01)	1.02E+02 (1.40E+01)
F27	**3.00E+02** = (1.11E-13)	3.30E+02 - (4.63E+01)	3.10E+02 (3.01E+01)	3.33E+02 - (2.79E+01)	**3.06E+02** + (1.65E+01)	3.16E+02 (2.46E+01)
F28	**7.92E+02** + (1.86E+01)	8.26E+02 - (8.10E+01)	8.09E+02 (2.06E+01)	**1.09E+03** + (3.20E+01)	1.28E+03 - (9.49E+01)	1.18E+03 (4.54E+01)
F29	7.20E+02 - (6.01E+00)	**5.75E+02** = (2.15E+02)	6.75E+02 (1.49E+02)	8.27E+02 - (5.63E+01)	1.03E+03 - (1.26E+02)	**6.01E+02** (7.52E+01)
F30	1.22E+03 - (4.61E+02)	5.18E+02 = (7.28E+01)	**5.01E+02** (8.89E+01)	**8.45E+03** + (4.59E+02)	9.90E+03 - (5.82E+02)	8.73E+03 (5.24E+02)
-/=/+	**15/11/4**	**13/13/4**		**18/8/4**	**15/8/7**	

TABLE S7 PERFORMANCE COMPARISONS OF VARIANT-III OF MLCC-SI WITH SHADE AND IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			*D* = 50		
	SHADE	IDE	Variant-III	SHADE	IDE	Variant-III
F1	**2.59E+02** + (5.67E+02)	1.18E+05 - (9.41E+04)	1.24E+03 (2.86E+03)	1.19E+05 = (6.14E+04)	1.24E+06 - (3.41E+05)	**1.15E+05** (5.07E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.28E+00 - (2.53E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	1.85E+01 - (1.27E+01)	6.86E-01 (4.90E+00)
F4	**0.00E+00** = (0.00E+00)	2.08E-02 - (4.14E-02)	**0.00E+00** (0.00E+00)	8.35E+01 + (1.16E+01)	**7.19E+01** = (2.97E+01)	8.27E+01 (6.01E+00)
F5	2.03E+01 = (3.54E-02)	**2.02E+01** + (5.68E-02)	2.03E+01 (5.46E-02)	2.05E+01 - (4.03E-02)	**2.03E+01** + (5.95E-02)	2.05E+01 (5.56E-02)
F6	6.41E+00 - (3.86E+00)	**6.20E-02** + (2.82E-01)	1.11E+00 (1.25E+00)	1.18E+00 = (3.45E+00)	**9.34E-02** + (3.14E-01)	3.76E-01 (5.11E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.22E-03 - (4.10E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	4.33E-10 = (3.09E-09)	**0.00E+00** (0.00E+00)	**1.84E-02** + (5.39E-03)	4.32E-02 + (1.97E-01)	9.25E+00 (1.43E+00)
F9	2.75E+01 - (4.18E+00)	2.46E+01 - (5.33E+00)	**2.13E+01** (4.56E+00)	8.82E+01 - (8.25E+00)	5.99E+01 - (1.01E+01)	**5.25E+01** (1.22E+01)
F10	**1.57E-01** + (3.94E-02)	5.68E+00 + (1.66E+01)	6.05E+00 (2.83E+00)	6.06E+01 = (6.43E+00)	**3.34E+01** + (4.90E+01)	6.28E+01 (2.43E+01)
F11	1.97E+03 - (2.06E+02)	1.92E+03 = (3.53E+02)	**1.79E+03** (3.84E+02)	6.27E+03 - (3.93E+02)	**4.20E+03** + (6.65E+02)	5.31E+03 (5.31E+02)
F12	3.08E-01 = (4.82E-02)	**2.91E-01** = (5.97E-02)	3.12E-01 (5.74E-02)	6.12E-01 - (6.73E-02)	**3.68E-01** + (7.37E-02)	4.60E-01 (5.81E-02)
F13	2.15E-01 - (2.58E-02)	1.87E-01 = (2.20E-02)	**1.83E-01** (2.64E-02)	3.01E-01 - (2.99E-02)	2.96E-01 - (3.09E-02)	**2.84E-01** (2.77E-02)
F14	2.14E-01 - (2.24E-02)	**1.82E-01** = (3.19E-02)	1.97E-01 (2.49E-02)	**2.50E-01** + (1.82E-02)	2.70E-01 - (2.23E-02)	2.60E-01 (2.12E-02)
F15	3.83E+00 - (4.70E-01)	**2.69E+00** + (5.27E-01)	3.53E+00 (4.93E-01)	1.18E+01 - (8.02E-01)	**7.36E+00** + (1.93E+00)	1.09E+01 (1.19E+00)
F16	**9.55E+00** + (3.49E-01)	1.00E+01 - (3.94E-01)	9.81E+00 (3.51E-01)	**1.88E+01** = (2.77E-01)	1.92E+01 - (4.21E-01)	1.89E+01 (3.48E-01)
F17	7.62E+02 - (3.58E+02)	5.97E+02 - (2.97E+02)	**4.73E+02** (2.35E+02)	2.21E+03 - (5.57E+02)	7.22E+03 - (2.74E+03)	**1.79E+03** (4.48E+02)
F18	1.44E+01 = (7.28E+00)	1.90E+01 - (5.87E+00)	**1.25E+01** (4.86E+00)	8.03E+01 - (2.31E+01)	**3.93E+01** + (1.09E+01)	4.84E+01 (1.29E+01)
F19	4.01E+00 - (6.47E-01)	**2.91E+00** + (4.69E-01)	3.55E+00 (3.97E-01)	1.29E+01 - (5.85E+00)	**1.03E+01** + (7.50E-01)	1.11E+01 (3.11E+00)
F20	**4.96E+00** + (2.19E+00)	1.08E+01 - (3.24E+00)	6.05E+00 (2.00E+00)	4.11E+01 = (1.63E+01)	4.54E+01 - (1.04E+01)	**3.98E+01** (1.35E+01)
F21	**1.29E+02** = (8.62E+01)	3.30E+02 - (1.54E+02)	1.40E+02 (6.83E+01)	9.75E+02 - (2.81E+02)	1.23E+03 - (3.77E+02)	**6.57E+02** (2.10E+02)
F22	1.23E+02 - (5.85E+01)	7.30E+01 = (5.78E+01)	**5.15E+01** (4.37E+01)	4.85E+02 - (1.22E+02)	3.04E+02 = (1.06E+02)	**2.70E+02** (1.03E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** + (3.46E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** = (4.46E-13)	**3.44E+02** (4.67E-13)
F24	**2.23E+02** = (9.22E-01)	**2.23E+02** = (7.24E-01)	**2.23E+02** (7.26E-01)	2.69E+02 - (1.90E+00)	**2.58E+02** + (3.39E+00)	2.59E+02 (3.67E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** = (2.33E-01)	**2.03E+02** (4.66E-01)	2.11E+02 - (2.59E+00)	**2.07E+02** - (6.05E-01)	**2.07E+02** (1.36E+00)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (2.60E-02)	**1.00E+02** (2.64E-02)	**1.00E+02** - (3.37E-02)	1.06E+02 = (2.37E+01)	**1.00E+02** (2.49E-02)
F27	**3.00E+02** + (1.11E-13)	3.30E+02 = (4.63E+01)	3.30E+02 (4.62E+01)	3.33E+02 - (2.79E+01)	**3.06E+02** + (1.65E+01)	3.14E+02 (2.39E+01)
F28	**7.92E+02** + (1.86E+01)	8.26E+02 - (8.10E+01)	8.05E+02 (2.83E+01)	**1.09E+03** + (3.20E+01)	1.28E+03 - (9.49E+01)	1.16E+03 (3.82E+01)
F29	7.20E+02 - (6.01E+00)	**5.75E+02** = (2.15E+02)	6.36E+02 (1.92E+02)	8.27E+02 - (5.63E+01)	1.03E+03 - (1.26E+02)	**5.84E+02** (8.30E+01)
F30	1.22E+03 - (4.61E+02)	**5.18E+02** = (7.28E+01)	5.36E+02 (1.53E+02)	**8.45E+03** + (4.59E+02)	9.90E+03 - (5.82E+02)	8.82E+03 (4.19E+02)
-/=/+	**13/11/6**	**9/15/6**		**16/9/5**	**15/4/11**	

TABLE S8 PERFORMANCE COMPARISONS OF VARIANT-IV OF MLCC-SI WITH SHADE AND IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			*D* = 50		
	SHADE	IDE	Variant-IV	SHADE	IDE	Variant-IV
F1	**2.59E+02** + (5.67E+02)	1.18E+05 - (9.41E+04)	3.49E+03 (3.73E+03)	**1.19E+05** + (6.14E+04)	1.24E+06 - (3.41E+05)	2.42E+05 (8.92E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** + (0.00E+00)	2.28E+00 - (2.53E+00)	1.07E-04 (1.41E-04)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	1.85E+01 - (1.27E+01)	4.25E-01 (3.03E+00)
F4	**0.00E+00** + (0.00E+00)	2.08E-02 - (4.14E-02)	6.03E-07 (2.29E-06)	8.35E+01 = (1.16E+01)	7.19E+01 - (2.97E+01)	**7.00E+01** (2.53E+01)
F5	2.03E+01 + (3.54E-02)	**2.02E+01** + (5.68E-02)	2.04E+01 (4.56E-02)	2.05E+01 + (4.03E-02)	**2.03E+01** + (5.95E-02)	2.06E+01 (4.04E-02)
F6	6.41E+00 - (3.86E+00)	6.20E-02 - (2.82E-01)	**2.69E-02** (9.09E-02)	1.18E+00 - (3.45E+00)	**9.34E-02** + (3.14E-01)	2.06E-01 (3.89E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.22E-03 - (4.10E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	4.33E-10 = (3.09E-09)	**0.00E+00** (0.00E+00)	1.84E-02 - (5.39E-03)	4.32E-02 - (1.97E-01)	**1.33E-07** (2.57E-07)
F9	2.75E+01 - (4.18E+00)	2.46E+01 - (5.33E+00)	**2.03E+01** (4.26E+00)	8.82E+01 - (8.25E+00)	5.99E+01 - (1.01E+01)	**4.36E+01** (8.45E+00)
F10	**1.57E-01** + (3.94E-02)	5.68E+00 - (1.66E+01)	2.56E+00 (1.73E+00)	6.06E+01 - (6.43E+00)	3.34E+01 + (4.90E+01)	**1.81E+01** (9.40E+00)
F11	1.97E+03 - (2.06E+02)	1.92E+03 - (3.53E+02)	**1.70E+03** (3.59E+02)	6.27E+03 - (3.93E+02)	4.20E+03 - (6.65E+02)	**3.92E+03** (6.72E+02)
F12	3.08E-01 + (4.82E-02)	**2.91E-01** + (5.97E-02)	3.84E-01 (7.25E-02)	6.12E-01 = (6.73E-02)	**3.68E-01** + (7.37E-02)	5.93E-01 (6.83E-02)
F13	2.15E-01 - (2.58E-02)	**1.87E-01** + (2.20E-02)	1.98E-01 (2.03E-02)	3.01E-01 - (2.99E-02)	2.96E-01 = (3.09E-02)	**2.84E-01** (2.73E-02)
F14	2.14E-01 - (2.24E-02)	**1.82E-01** + (3.19E-02)	2.00E-01 (2.48E-02)	**2.50E-01** + (1.82E-02)	2.70E-01 = (2.23E-02)	2.63E-01 (2.32E-02)
F15	3.83E+00 - (4.70E-01)	2.69E+00 = (5.27E-01)	**2.63E+00** (4.98E-01)	1.18E+01 - (8.02E-01)	7.36E+00 = (1.93E+00)	**7.29E+00** (1.95E+00)
F16	**9.55E+00** + (3.49E-01)	1.00E+01 - (3.94E-01)	9.79E+00 (3.48E-01)	**1.88E+01** = (2.77E-01)	1.92E+01 - (4.21E-01)	1.89E+01 (3.95E-01)
F17	7.62E+02 - (3.58E+02)	5.97E+02 - (2.97E+02)	**2.56E+02** (1.43E+02)	2.21E+03 - (5.57E+02)	7.22E+03 - (2.74E+03)	**1.26E+03** (4.55E+02)
F18	1.44E+01 - (7.28E+00)	1.90E+01 - (5.87E+00)	**9.36E+00** (3.28E+00)	8.03E+01 - (2.31E+01)	3.93E+01 - (1.09E+01)	**2.93E+01** (9.31E+00)
F19	4.01E+00 - (6.47E-01)	**2.91E+00** = (4.69E-01)	3.06E+00 (4.65E-01)	1.29E+01 - (5.85E+00)	1.03E+01 - (7.50E-01)	**1.00E+01** (4.58E-01)
F20	**4.96E+00** + (2.19E+00)	1.08E+01 - (3.24E+00)	5.72E+00 (1.76E+00)	4.11E+01 - (1.63E+01)	4.54E+01 - (1.04E+01)	**2.56E+01** (6.76E+00)
F21	1.29E+02 = (8.62E+01)	3.30E+02 - (1.54E+02)	**1.09E+02** (6.86E+01)	9.75E+02 - (2.81E+02)	1.23E+03 - (3.77E+02)	**5.62E+02** (1.86E+02)
F22	1.23E+02 - (5.85E+01)	7.30E+01 = (5.78E+01)	**5.74E+01** (5.13E+01)	4.85E+02 - (1.22E+02)	3.04E+02 = (1.06E+02)	**2.76E+02** (1.08E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** + (3.46E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** = (4.46E-13)	**3.44E+02** (4.25E-13)
F24	**2.23E+02** = (9.22E-01)	**2.23E+02** - (7.24E-01)	**2.23E+02** (7.66E-01)	2.69E+02 - (1.90E+00)	**2.58E+02** + (3.39E+00)	**2.58E+02** (1.55E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** = (2.33E-01)	**2.03E+02** (2.87E-01)	2.11E+02 - (2.59E+00)	2.07E+02 - (6.05E-01)	**2.06E+02** (6.65E-01)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (2.60E-02)	**1.00E+02** (2.70E-02)	**1.00E+02** - (3.37E-02)	1.06E+02 = (2.37E+01)	1.02E+02 (1.40E+01)
F27	**3.00E+02** = (1.11E-13)	3.30E+02 - (4.63E+01)	3.08E+02 (2.72E+01)	3.33E+02 - (2.79E+01)	**3.06E+02** = (1.65E+01)	3.13E+02 (2.17E+01)
F28	**7.92E+02** = (1.86E+01)	8.26E+02 - (8.10E+01)	7.97E+02 (2.09E+01)	**1.09E+03** + (3.20E+01)	1.28E+03 - (9.49E+01)	1.13E+03 (3.19E+01)
F29	7.20E+02 - (6.01E+00)	**5.75E+02** = (2.15E+02)	6.64E+02 (1.69E+02)	8.27E+02 - (5.63E+01)	1.03E+03 - (1.26E+02)	**6.15E+02** (1.09E+02)
F30	1.22E+03 - (4.61E+02)	5.18E+02 = (7.28E+01)	**5.15E+02** (1.12E+02)	**8.45E+03** + (4.59E+02)	9.90E+03 - (5.82E+02)	8.67E+03 (4.38E+02)
-/=/+	**14/9/7**	**14/11/5**		**18/6/6**	**18/7/5**	

TABLE S9 PERFORMANCE COMPARISONS OF MLCC-SI WITH ITS VARIANTS WITH DIFFERENT *N* SETTINGS ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	Setting-I	Setting-II	Setting-III	Setting-IV	Setting-V	Setting-VI	MLCC-SI
F1	4.37E+03 = (4.52E+03)	3.06E+03 = (3.89E+03)	2.77E+03 + (3.01E+03)	2.54E+03 + (3.80E+03)	6.58E+03 = (6.94E+03)	**2.42E+03** + (3.14E+03)	4.76E+03 (5.69E+03)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F4	6.55E-08 = (1.72E-07)	**6.05E-08** = (1.74E-07)	9.48E-08 = (3.44E-07)	1.20E-05 - (4.80E-05)	8.44E-07 = (4.16E-06)	1.47E+00 - (9.24E+00)	1.63E-07 (4.37E-07)
F5	**2.02E+01** = (4.40E-02)	**2.02E+01** = (3.39E-02)	**2.02E+01** = (4.66E-02)	**2.02E+01** = (5.22E-02)	**2.02E+01** - (5.80E-02)	**2.02E+01** - (5.91E-02)	**2.02E+01** (5.40E-02)
F6	**8.51E-02** = (2.59E-01)	5.29E-01 = (1.36E+00)	2.60E-01 - (7.68E-01)	2.16E+00 = (3.11E+00)	2.05E-01 = (6.71E-01)	2.05E+00 = (3.77E+00)	8.71E-02 (2.84E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	2.18E-09 = (1.08E-08)	2.75E-10 = (1.96E-09)	**0.00E+00** = (0.00E+00)	1.01E-06 - (2.37E-06)	**0.00E+00** (0.00E+00)
F9	2.13E+01 = (3.69E+00)	2.20E+01 = (3.77E+00)	**2.10E+01** = (3.77E+00)	2.17E+01 = (3.47E+00)	2.12E+01 = (5.05E+00)	2.37E+01 - (3.40E+00)	2.14E+01 (4.44E+00)
F10	9.84E-01 = (8.83E-01)	**7.44E-01** = (5.15E-01)	2.72E+00 - (1.13E+00)	9.15E+00 - (2.85E+00)	2.22E+00 - (1.69E+00)	1.35E+01 - (3.45E+00)	1.12E+00 (9.49E-01)
F11	1.66E+03 = (3.36E+02)	1.70E+03 = (2.63E+02)	**1.62E+03** = (3.47E+02)	1.80E+03 - (2.43E+02)	1.74E+03 = (3.05E+02)	1.91E+03 - (2.87E+02)	1.63E+03 (3.34E+02)
F12	2.50E-01 = (5.18E-02)	2.30E-01 + (5.63E-02)	**2.29E-01** + (5.18E-02)	2.41E-01 = (4.97E-02)	2.82E-01 = (7.75E-02)	2.68E-01 = (5.76E-02)	2.60E-01 (5.31E-02)
F13	**1.80E-01** = (2.96E-02)	1.83E-01 = (2.21E-02)	1.84E-01 = (2.17E-02)	1.85E-01 = (2.46E-02)	1.91E-01 = (2.57E-02)	1.89E-01 = (2.78E-02)	1.83E-01 (2.79E-02)
F14	1.92E-01 = (2.36E-02)	**1.91E-01** = (3.01E-02)	1.99E-01 = (2.11E-02)	1.92E-01 = (2.16E-02)	2.00E-01 = (2.68E-02)	1.92E-01 = (2.75E-02)	1.94E-01 (2.21E-02)
F15	2.56E+00 = (5.17E-01)	2.48E+00 = (5.71E-01)	3.06E+00 - (5.16E-01)	3.14E+00 - (4.10E-01)	2.68E+00 - (5.12E-01)	3.43E+00 - (4.84E-01)	**2.47E+00** (4.20E-01)
F16	9.53E+00 = (4.72E-01)	9.55E+00 = (4.89E-01)	9.60E+00 = (4.20E-01)	9.56E+00 = (4.43E-01)	9.66E+00 = (4.65E-01)	9.65E+00 = (4.32E-01)	**9.52E+00** (4.66E-01)
F17	2.51E+02 = (1.33E+02)	2.41E+02 = (1.26E+02)	2.87E+02 = (1.52E+02)	3.23E+02 - (1.66E+02)	2.61E+02 = (1.52E+02)	2.93E+02 - (1.46E+02)	**2.31E+02** (1.23E+02)
F18	1.01E+01 = (3.49E+00)	1.02E+01 = (3.76E+00)	**8.76E+00** = (3.17E+00)	9.91E+00 = (4.73E+00)	9.67E+00 = (3.64E+00)	1.11E+01 = (4.15E+00)	9.79E+00 (3.36E+00)
F19	**2.99E+00** = (5.33E-01)	3.13E+00 = (5.12E-01)	3.33E+00 - (5.66E-01)	3.45E+00 - (4.47E-01)	3.01E+00 = (5.26E-01)	3.48E+00 - (5.39E-01)	3.02E+00 (5.37E-01)
F20	5.73E+00 = (1.54E+00)	6.12E+00 = (1.55E+00)	6.56E+00 = (2.03E+00)	5.77E+00 = (2.10E+00)	**5.69E+00** = (1.96E+00)	5.95E+00 = (1.68E+00)	5.91E+00 (1.42E+00)
F21	1.02E+02 = (7.67E+01)	9.17E+01 = (7.73E+01)	**8.88E+01** = (7.67E+01)	9.88E+01 = (8.09E+01)	1.01E+02 = (8.98E+01)	1.12E+02 = (7.94E+01)	1.04E+02 (7.65E+01)
F22	4.79E+01 - (4.73E+01)	6.05E+01 - (5.51E+01)	7.10E+01 - (5.74E+01)	6.42E+01 - (5.25E+01)	6.25E+01 - (5.49E+01)	7.57E+01 - (5.66E+01)	**3.55E+01** (3.45E+01)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** (4.02E-13)
F24	**2.23E+02** = (8.77E-01)	**2.23E+02** = (7.48E-01)	**2.23E+02** = (8.60E-01)	**2.23E+02** - (6.70E-01)	**2.23E+02** = (7.54E-01)	**2.23E+02** = (6.99E-01)	**2.23E+02** (7.91E-01)
F25	**2.03E+02** = (3.36E-01)	**2.03E+02** = (3.37E-01)	**2.03E+02** = (2.54E-01)	**2.03E+02** = (3.33E-01)	**2.03E+02** = (3.25E-01)	**2.03E+02** = (3.37E-01)	**2.03E+02** (2.95E-01)
F26	**1.00E+02** = (2.69E-02)	**1.00E+02** = (2.57E-02)	**1.00E+02** = (2.55E-02)	**1.00E+02** = (2.49E-02)	**1.00E+02** = (2.87E-02)	**1.00E+02** = (2.75E-02)	**1.00E+02** (2.41E-02)
F27	3.10E+02 + (3.02E+01)	3.20E+02 + (4.03E+01)	**3.06E+02** + (2.38E+01)	3.20E+02 + (4.02E+01)	3.10E+02 + (3.02E+01)	3.22E+02 + (4.17E+01)	3.47E+02 (5.07E+01)
F28	8.00E+02 - (2.39E+01)	8.06E+02 - (2.84E+01)	8.07E+02 - (2.93E+01)	8.06E+02 - (2.52E+01)	7.93E+02 = (2.98E+01)	8.14E+02 - (2.40E+01)	**7.89E+02** (3.09E+01)
F29	6.78E+02 = (1.49E+02)	**6.39E+02** = (1.97E+02)	6.64E+02 = (1.71E+02)	6.56E+02 + (1.74E+02)	6.52E+02 = (1.82E+02)	6.55E+02 + (1.72E+02)	6.94E+02 (1.27E+02)
F30	4.91E+02 = (7.94E+01)	5.10E+02 = (1.10E+02)	5.24E+02 = (1.12E+02)	5.10E+02 = (1.03E+02)	5.15E+02 = (1.23E+02)	**4.60E+02** + (8.15E+01)	5.20E+02 (1.60E+02)
-/=/+	**2/27/1**	**2/26/2**	**6/21/3**	**9/18/3**	**4/25/1**	**11/15/4**	

TABLE S10 PERFORMANCE COMPARISONS OF MLCC-SBI WITH SHADE AND BIDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			*D* = 50		
	SHADE	BiDE	MLCC-SBi	SHADE	BiDE	MLCC-SBi
F1	**2.59E+02** = (5.67E+02)	3.00E+02 = (6.19E+02)	1.08E+03 (2.59E+03)	1.19E+05 - (6.14E+04)	1.55E+05 - (8.27E+04)	**8.14E+04** (4.33E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	5.06E-04 - (5.12E-04)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F4	**0.00E+00** = (0.00E+00)	2.57E-08 - (4.92E-08)	2.49E+00 (1.24E+01)	8.35E+01 - (1.16E+01)	**3.32E+01** = (3.64E+01)	4.15E+01 (4.26E+01)
F5	2.03E+01 - (3.54E-02)	**2.01E+01** = (1.22E-01)	2.02E+01 (1.05E-01)	**2.05E+01** = (4.03E-02)	2.07E+01 - (8.52E-02)	**2.05E+01** (6.14E-02)
F6	6.41E+00 - (3.86E+00)	5.74E-01 = (8.99E-01)	**3.37E-01** (6.95E-01)	**1.18E+00** = (3.45E+00)	6.35E+00 - (1.01E+01)	2.01E+00 (4.58E+00)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	2.14E-03 - (3.25E-03)	**0.00E+00** (0.00E+00)	**1.84E-02** + (5.39E-03)	5.98E+01 - (4.25E+00)	1.11E+01 (1.86E+00)
F9	**2.75E+01** = (4.18E+00)	3.18E+01 = (7.22E+00)	2.92E+01 (7.00E+00)	8.82E+01 - (8.25E+00)	1.99E+02 - (3.82E+01)	**5.63E+01** (1.11E+01)
F10	**1.57E-01** + (3.94E-02)	1.20E+02 - (2.69E+01)	8.92E+00 (3.15E+00)	**6.06E+01** + (6.43E+00)	2.36E+03 - (3.27E+02)	2.89E+02 (8.55E+01)
F11	1.97E+03 - (2.06E+02)	**1.59E+03** = (4.02E+02)	1.66E+03 (4.45E+02)	6.27E+03 - (3.93E+02)	7.96E+03 - (1.40E+03)	**4.72E+03** (6.92E+02)
F12	3.08E-01 - (4.82E-02)	1.61E-01 = (8.44E-02)	**1.31E-01** (5.88E-02)	6.12E-01 - (6.73E-02)	1.02E+00 - (2.76E-01)	**5.69E-01** (1.15E-01)
F13	2.15E-01 - (2.58E-02)	2.08E-01 - (4.34E-02)	**1.86E-01** (3.02E-02)	3.01E-01 = (2.99E-02)	**2.95E-01** = (5.23E-02)	3.02E-01 (3.96E-02)
F14	2.14E-01 = (2.24E-02)	2.14E-01 = (2.89E-02)	**2.11E-01** (2.92E-02)	2.50E-01 = (1.82E-02)	2.52E-01 = (3.45E-02)	**2.49E-01** (2.50E-02)
F15	3.83E+00 - (4.70E-01)	3.18E+00 = (8.94E-01)	**2.88E+00** (7.18E-01)	1.18E+01 - (8.02E-01)	1.97E+01 - (3.82E+00)	**8.11E+00** (2.19E+00)
F16	9.55E+00 - (3.49E-01)	9.36E+00 - (5.31E-01)	**9.01E+00** (5.27E-01)	1.88E+01 = (2.77E-01)	2.02E+01 - (6.30E-01)	**1.87E+01** (5.37E-01)
F17	7.62E+02 - (3.58E+02)	**2.12E+02** = (1.38E+02)	2.35E+02 (1.52E+02)	2.21E+03 - (5.57E+02)	1.38E+03 - (5.57E+02)	**1.07E+03** (4.18E+02)
F18	1.44E+01 - (7.28E+00)	**8.57E+00** = (3.34E+00)	9.55E+00 (3.67E+00)	8.03E+01 - (2.31E+01)	5.25E+01 - (2.42E+01)	**2.98E+01** (1.08E+01)
F19	4.01E+00 - (6.47E-01)	**2.62E+00** = (6.55E-01)	2.71E+00 (7.03E-01)	1.29E+01 - (5.85E+00)	1.14E+01 - (7.45E-01)	**1.09E+01** (6.03E-01)
F20	**4.96E+00** = (2.19E+00)	8.37E+00 - (2.35E+00)	5.32E+00 (1.85E+00)	4.11E+01 - (1.63E+01)	3.31E+01 - (9.20E+00)	**2.38E+01** (6.17E+00)
F21	1.29E+02 = (8.62E+01)	1.28E+02 = (1.16E+02)	**1.14E+02** (8.33E+01)	9.75E+02 - (2.81E+02)	8.62E+02 - (2.94E+02)	**4.83E+02** (1.92E+02)
F22	1.23E+02 - (5.85E+01)	9.45E+01 = (8.43E+01)	**7.50E+01** (5.97E+01)	4.85E+02 - (1.22E+02)	3.86E+02 - (1.51E+02)	**3.10E+02** (1.47E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** - (4.12E-13)	**3.44E+02** (4.18E-13)
F24	2.23E+02 = (9.22E-01)	**2.20E+02** + (6.75E+00)	2.23E+02 (9.03E-01)	2.69E+02 = (1.90E+00)	**2.68E+02** + (1.76E+00)	**2.68E+02** (1.86E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** + (2.16E-01)	**2.03E+02** (2.15E-01)	2.11E+02 - (2.59E+00)	**2.05E+02** + (3.66E-01)	2.06E+02 (4.68E-01)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (4.89E-02)	**1.00E+02** (2.70E-02)	**1.00E+02** = (3.37E-02)	**1.00E+02** = (5.58E-02)	**1.00E+02** (4.07E-02)
F27	**3.00E+02** + (1.11E-13)	3.19E+02 = (3.86E+01)	3.47E+02 (5.07E+01)	**3.33E+02** = (2.79E+01)	3.38E+02 = (2.77E+01)	3.39E+02 (3.23E+01)
F28	7.92E+02 = (1.86E+01)	**7.88E+02** = (3.63E+01)	7.97E+02 (2.41E+01)	**1.09E+03** = (3.20E+01)	1.16E+03 - (7.13E+01)	**1.09E+03** (3.91E+01)
F29	7.20E+02 - (6.01E+00)	**7.16E+02** + (1.54E+00)	7.17E+02 (3.38E+00)	8.27E+02 - (5.63E+01)	**7.64E+02** + (4.63E+01)	8.08E+02 (4.03E+01)
F30	1.22E+03 - (4.61E+02)	**7.30E+02** = (3.02E+02)	8.27E+02 (3.25E+02)	8.45E+03 - (4.59E+02)	**8.21E+03** = (2.49E+02)	8.33E+03 (3.81E+02)
-/=/+	**15/13/2**	**6/21/3**		**15/13/2**	**19/8/3**	

TABLE S11 PERFORMANCE COMPARISONS OF BIDE WITH SHADE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30		*D* = 50	
	SHADE	BiDE	SHADE	BiDE
F1	2.59E+02 = (5.67E+02)	3.00E+02 (6.19E+02)	1.19E+05 + (6.14E+04)	1.55E+05 (8.27E+04)
F2	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	0.00E+00 + (0.00E+00)	5.06E-04 (5.12E-04)
F3	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)
F4	0.00E+00 + (0.00E+00)	2.57E-08 (4.92E-08)	8.35E+01 - (1.16E+01)	3.32E+01 (3.64E+01)
F5	2.03E+01 - (3.54E-02)	2.01E+01 (1.22E-01)	2.05E+01 + (4.03E-02)	2.07E+01 (8.52E-02)
F6	6.41E+00 - (3.86E+00)	5.74E-01 (8.99E-01)	1.18E+00 + (3.45E+00)	6.35E+00 (1.01E+01)
F7	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)
F8	0.00E+00 + (0.00E+00)	2.14E-03 (3.25E-03)	1.84E-02 + (5.39E-03)	5.98E+01 (4.25E+00)
F9	2.75E+01 + (4.18E+00)	3.18E+01 (7.22E+00)	8.82E+01 + (8.25E+00)	1.99E+02 (3.82E+01)
F10	1.57E-01 + (3.94E-02)	1.20E+02 (2.69E+01)	6.06E+01 + (6.43E+00)	2.36E+03 (3.27E+02)
F11	1.97E+03 - (2.06E+02)	1.59E+03 (4.02E+02)	6.27E+03 + (3.93E+02)	7.96E+03 (1.40E+03)
F12	3.08E-01 - (4.82E-02)	1.61E-01 (8.44E-02)	6.12E-01 + (6.73E-02)	1.02E+00 (2.76E-01)
F13	2.15E-01 = (2.58E-02)	2.08E-01 (4.34E-02)	3.01E-01 = (2.99E-02)	2.95E-01 (5.23E-02)
F14	2.14E-01 = (2.24E-02)	2.14E-01 (2.89E-02)	2.50E-01 = (1.82E-02)	2.52E-01 (3.45E-02)
F15	3.83E+00 - (4.70E-01)	3.18E+00 (8.94E-01)	1.18E+01 + (8.02E-01)	1.97E+01 (3.82E+00)
F16	9.55E+00 = (3.49E-01)	9.36E+00 (5.31E-01)	1.88E+01 + (2.77E-01)	2.02E+01 (6.30E-01)
F17	7.62E+02 - (3.58E+02)	2.12E+02 (1.38E+02)	2.21E+03 - (5.57E+02)	1.38E+03 (5.57E+02)
F18	1.44E+01 - (7.28E+00)	8.57E+00 (3.34E+00)	8.03E+01 - (2.31E+01)	5.25E+01 (2.42E+01)
F19	4.01E+00 - (6.47E-01)	2.62E+00 (6.55E-01)	1.29E+01 = (5.85E+00)	1.14E+01 (7.45E-01)
F20	4.96E+00 + (2.19E+00)	8.37E+00 (2.35E+00)	4.11E+01 - (1.63E+01)	3.31E+01 (9.20E+00)
F21	1.29E+02 = (8.62E+01)	1.28E+02 (1.16E+02)	9.75E+02 - (2.81E+02)	8.62E+02 (2.94E+02)
F22	1.23E+02 - (5.85E+01)	9.45E+01 (8.43E+01)	4.85E+02 - (1.22E+02)	3.86E+02 (1.51E+02)
F23	3.15E+02 = (4.02E-13)	3.15E+02 (4.02E-13)	3.44E+02 + (4.60E-13)	3.44E+02 (4.12E-13)
F24	2.23E+02 - (9.22E-01)	2.20E+02 (6.75E+00)	2.69E+02 - (1.90E+00)	2.68E+02 (1.76E+00)
F25	2.04E+02 - (7.68E-01)	2.03E+02 (2.16E-01)	2.11E+02 - (2.59E+00)	2.05E+02 (3.66E-01)
F26	1.00E+02 - (2.79E-02)	1.00E+02 (4.89E-02)	1.00E+02 = (3.37E-02)	1.00E+02 (5.58E-02)
F27	3.00E+02 + (1.11E-13)	3.19E+02 (3.86E+01)	3.33E+02 = (2.79E+01)	3.38E+02 (2.77E+01)
F28	7.92E+02 = (1.86E+01)	7.88E+02 (3.63E+01)	1.09E+03 + (3.20E+01)	1.16E+03 (7.13E+01)
F29	7.20E+02 - (6.01E+00)	7.16E+02 (1.54E+00)	8.27E+02 - (5.63E+01)	7.64E+02 (4.63E+01)
F30	1.22E+03 - (4.61E+02)	7.30E+02 (3.02E+02)	8.45E+03 - (4.59E+02)	8.21E+03 (2.49E+02)
-/=/+	14/10/6		10/7/13	

TABLE S12 PERFORMANCE COMPARISONS OF MLCC-SI AND MLCC-SBI WITH H-SI AND H-SBI RESPECTIVELY ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30		*D* = 50		*D* = 30		*D* = 50	
	H-SI	MLCC-SI	H-SI	MLCC-SI	H-SBi	MLCC-SBi	H-SBi	MLCC-SBi
F1	**2.03E+03** + (3.50E+03)	4.76E+03 (5.69E+03)	**2.00E+05** + (9.24E+04)	2.79E+05 (1.00E+05)	**7.32E+02** = (1.44E+03)	1.08E+03 (2.59E+03)	8.43E+04 = (3.70E+04)	**8.14E+04** (4.33E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** + (0.00E+00)	2.67E-04 (3.59E-04)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.10E-10 (1.50E-09)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F4	**4.37E-08** + (2.37E-07)	1.63E-07 (4.37E-07)	6.91E+01 - (2.78E+01)	**6.53E+01** (2.62E+01)	**0.00E+00** = (0.00E+00)	2.49E+00 (1.24E+01)	**3.41E+01** = (3.72E+01)	4.15E+01 (4.26E+01)
F5	2.03E+01 - (4.71E-02)	**2.02E+01** (5.40E-02)	2.05E+01 - (6.29E-02)	**2.03E+01** (5.46E-02)	2.04E+01 - (4.75E-02)	**2.02E+01** (1.05E-01)	2.06E+01 - (3.14E-02)	**2.05E+01** (6.14E-02)
F6	1.93E-01 = (7.82E-01)	**8.71E-02** (2.84E-01)	**8.49E-02** + (2.56E-01)	3.96E-01 (5.61E-01)	1.63E+00 = (3.17E+00)	**3.37E-01** (6.95E-01)	3.41E+00 - (7.42E+00)	**2.01E+00** (4.58E+00)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	1.25E-01 - (1.13E-01)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	1.46E+01 - (2.20E+00)	**1.11E+01** (1.86E+00)
F9	2.28E+01 = (4.05E+00)	**2.14E+01** (4.44E+00)	6.66E+01 - (1.50E+01)	**4.47E+01** (8.15E+00)	3.45E+01 - (9.19E+00)	**2.92E+01** (7.00E+00)	1.44E+02 - (1.43E+01)	**5.63E+01** (1.11E+01)
F10	7.29E+00 - (2.40E+00)	**1.12E+00** (9.49E-01)	1.35E+02 - (4.19E+01)	**9.00E+00** (3.38E+00)	9.37E+00 = (1.79E+00)	**8.92E+00** (3.15E+00)	4.94E+02 - (7.78E+01)	**2.89E+02** (8.55E+01)
F11	2.02E+03 - (2.98E+02)	**1.63E+03** (3.34E+02)	5.69E+03 - (4.29E+02)	**4.03E+03** (5.06E+02)	2.54E+03 - (4.69E+02)	**1.66E+03** (4.45E+02)	7.44E+03 - (4.29E+02)	**4.72E+03** (6.92E+02)
F12	3.34E-01 - (7.30E-02)	**2.60E-01** (5.31E-02)	4.54E-01 - (7.42E-02)	**3.51E-01** (5.92E-02)	4.56E-01 - (1.04E-01)	**1.31E-01** (5.88E-02)	8.03E-01 - (7.58E-02)	**5.69E-01** (1.15E-01)
F13	1.84E-01 = (2.40E-02)	**1.83E-01** (2.79E-02)	**2.67E-01** = (2.46E-02)	2.77E-01 (2.58E-02)	2.09E-01 - (3.53E-02)	**1.86E-01** (3.02E-02)	3.07E-01 = (3.40E-02)	**3.02E-01** (3.96E-02)
F14	2.01E-01 = (2.79E-02)	**1.94E-01** (2.21E-02)	2.71E-01 - (2.44E-02)	**2.56E-01** (2.36E-02)	**1.99E-01** + (3.03E-02)	2.11E-01 (2.92E-02)	2.56E-01 = (2.31E-02)	**2.49E-01** (2.50E-02)
F15	3.95E+00 - (4.69E-01)	**2.47E+00** (4.20E-01)	1.18E+01 - (1.22E+00)	**6.41E+00** (1.34E+00)	4.85E+00 - (6.56E-01)	**2.88E+00** (7.18E-01)	1.59E+01 - (1.07E+00)	**8.11E+00** (2.19E+00)
F16	9.85E+00 - (3.53E-01)	**9.52E+00** (4.66E-01)	1.89E+01 - (3.89E-01)	**1.85E+01** (4.53E-01)	9.93E+00 - (4.04E-01)	**9.01E+00** (5.27E-01)	1.95E+01 - (2.97E-01)	**1.87E+01** (5.37E-01)
F17	4.33E+02 - (2.08E+02)	**2.31E+02** (1.23E+02)	1.80E+03 - (4.71E+02)	**1.27E+03** (4.01E+02)	2.96E+02 = (1.85E+02)	**2.35E+02** (1.52E+02)	1.38E+03 - (3.71E+02)	**1.07E+03** (4.18E+02)
F18	1.06E+01 = (4.68E+00)	**9.79E+00** (3.36E+00)	3.95E+01 = (1.23E+01)	**3.55E+01** (1.17E+01)	**8.69E+00** = (4.03E+00)	9.55E+00 (3.67E+00)	3.00E+01 = (1.02E+01)	**2.98E+01** (1.08E+01)
F19	3.53E+00 - (5.35E-01)	**3.02E+00** (5.37E-01)	1.08E+01 - (2.98E-01)	**9.87E+00** (3.98E-01)	3.54E+00 - (6.75E-01)	**2.71E+00** (7.03E-01)	1.15E+01 - (6.96E-01)	**1.09E+01** (6.03E-01)
F20	**5.35E+00** + (1.64E+00)	5.91E+00 (1.42E+00)	3.17E+01 - (9.21E+00)	**2.53E+01** (6.78E+00)	5.82E+00 = (1.74E+00)	**5.32E+00** (1.85E+00)	2.60E+01 = (9.78E+00)	**2.38E+01** (6.17E+00)
F21	**1.03E+02** = (7.73E+01)	1.04E+02 (7.65E+01)	6.90E+02 - (2.57E+02)	**5.42E+02** (1.92E+02)	1.35E+02 = (1.05E+02)	**1.14E+02** (8.33E+01)	**4.81E+02** = (1.67E+02)	4.83E+02 (1.92E+02)
F22	6.13E+01 - (5.16E+01)	**3.55E+01** (3.45E+01)	**2.44E+02** = (1.20E+02)	2.75E+02 (1.13E+02)	8.21E+01 = (6.15E+01)	**7.50E+01** (5.97E+01)	**2.69E+02** = (1.34E+02)	3.10E+02 (1.47E+02)
F23	**3.15E+02** + (2.83E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** + (2.87E-13)	**3.44E+02** (4.18E-13)	**3.15E+02** = (4.29E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** + (2.87E-13)	**3.44E+02** (4.18E-13)
F24	**2.23E+02** = (8.27E-01)	**2.23E+02** (7.91E-01)	2.60E+02 = (4.63E+00)	**2.58E+02** (2.93E+00)	**2.23E+02** = (7.78E-01)	**2.23E+02** (9.03E-01)	2.69E+02 - (1.96E+00)	**2.68E+02** (1.86E+00)
F25	**2.03E+02** = (3.09E-01)	**2.03E+02** (2.95E-01)	2.07E+02 = (1.02E+00)	**2.06E+02** (8.22E-01)	**2.03E+02** = (3.62E-01)	**2.03E+02** (2.15E-01)	**2.06E+02** - (5.74E-01)	**2.06E+02** (4.68E-01)
F26	**1.00E+02** = (2.34E-02)	**1.00E+02** (2.41E-02)	**1.00E+02** = (2.41E-02)	**1.00E+02** (2.83E-02)	**1.00E+02** = (3.12E-02)	**1.00E+02** (2.70E-02)	**1.00E+02** = (3.88E-02)	**1.00E+02** (4.07E-02)
F27	**3.08E+02** + (2.73E+01)	3.47E+02 (5.07E+01)	**3.20E+02** = (2.47E+01)	**3.20E+02** (2.65E+01)	**3.11E+02** + (3.05E+01)	3.47E+02 (5.07E+01)	**3.23E+02** = (2.38E+01)	3.39E+02 (3.23E+01)
F28	8.02E+02 - (2.37E+01)	**7.89E+02** (3.09E+01)	**1.16E+03** = (4.35E+01)	**1.16E+03** (3.60E+01)	**7.84E+02** + (1.83E+01)	7.97E+02 (2.41E+01)	1.14E+03 - (8.02E+01)	**1.09E+03** (3.91E+01)
F29	**6.86E+02** + (1.27E+02)	6.94E+02 (1.27E+02)	**6.17E+02** = (9.07E+01)	6.22E+02 (1.41E+02)	7.18E+02 = (3.78E+00)	**7.17E+02** (3.38E+00)	**8.02E+02** = (3.53E+01)	8.08E+02 (4.03E+01)
F30	**5.17E+02** = (1.26E+02)	5.20E+02 (1.60E+02)	**8.58E+03** = (4.57E+02)	8.61E+03 (3.99E+02)	**7.30E+02** = (3.17E+02)	8.27E+02 (3.25E+02)	8.43E+03 = (4.65E+02)	**8.33E+03** (3.81E+02)
-/=/+	**10/14/6**		**14/12/4**		**8/19/3**		**14/15/1**	

TABLE S13 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 30-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	SinDE	MPEDE	MLCCDE
F1	5.86E+04 - (4.66E+04)	6.85E+04 - (5.67E+04)	1.51E+04 = (3.18E+04)	1.75E+03 + (2.27E+03)	2.33E+04 - (1.76E+04)	1.97E+04 - (1.43E+04)	1.05E+06 - (4.82E+05)	**0.00E+00** + (0.00E+00)	7.47E+03 (5.58E+03)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	4.51E-04 = (3.18E-03)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F4	5.19E+00 - (1.45E+01)	2.03E+00 - (9.06E+00)	3.45E+00 - (1.78E+00)	1.24E+00 = (8.88E+00)	5.06E+00 - (1.75E+01)	8.64E-02 - (5.58E-01)	5.37E+00 - (1.53E+01)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F5	2.04E+01 - (3.53E-02)	2.09E+01 - (6.14E-02)	2.03E+01 - (4.05E-02)	2.03E+01 - (3.68E-02)	**2.00E+01** + (7.07E-02)	2.02E+01 = (2.74E-01)	2.05E+01 - (5.79E-02)	2.04E+01 - (4.94E-02)	2.02E+01 (4.60E-02)
F6	1.52E+00 - (2.87E+00)	2.29E+00 - (1.43E+00)	1.89E+01 - (1.36E+00)	8.64E+00 - (2.49E+00)	2.33E+00 - (1.63E+00)	1.28E+00 - (1.27E+00)	**2.16E-02** = (1.02E-01)	4.82E-01 - (6.52E-01)	8.01E-02 (3.94E-01)
F7	**0.00E+00** = (0.00E+00)	4.77E-03 - (9.01E-03)	1.21E-03 - (4.21E-03)	3.87E-04 = (1.99E-03)	4.35E-04 = (2.19E-03)	3.38E-04 = (1.71E-03)	**0.00E+00** = (0.00E+00)	7.25E-04 - (2.53E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	3.00E+00 - (1.71E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	2.04E-02 - (1.39E-01)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F9	4.25E+01 - (6.27E+00)	2.90E+01 - (8.26E+00)	4.29E+01 - (6.90E+00)	2.64E+01 - (4.51E+00)	4.01E+01 - (1.06E+01)	4.02E+01 - (1.06E+01)	3.04E+01 - (8.08E+00)	2.89E+01 - (8.20E+00)	**2.12E+01** (3.87E+00)
F10	**1.63E-03** + (5.65E-03)	3.71E+01 - (3.14E+01)	2.22E-01 + (1.93E-01)	7.76E-03 + (1.17E-02)	4.75E-01 = (6.22E-01)	3.23E+01 - (1.26E+01)	6.06E+00 - (2.71E+00)	1.13E+00 - (5.33E-01)	5.01E-01 (5.72E-01)
F11	2.51E+03 - (2.57E+02)	5.15E+03 - (4.53E+02)	3.60E+03 - (4.26E+02)	**1.65E+03** = (2.45E+02)	1.80E+03 = (4.99E+02)	1.81E+03 = (5.37E+02)	1.68E+03 = (4.18E+02)	2.35E+03 - (4.57E+02)	1.72E+03 (3.31E+02)
F12	4.76E-01 - (6.04E-02)	1.74E+00 - (2.32E-01)	5.13E-01 - (4.94E-02)	2.57E-01 - (4.16E-02)	**7.03E-02** + (5.33E-02)	1.46E-01 + (2.35E-01)	4.93E-01 - (1.37E-01)	4.88E-01 - (1.03E-01)	2.09E-01 (5.46E-02)
F13	2.89E-01 - (4.08E-02)	2.51E-01 - (3.69E-02)	2.52E-01 - (4.03E-02)	2.08E-01 - (3.02E-02)	2.35E-01 - (5.12E-02)	2.28E-01 - (5.14E-02)	**1.50E-01** + (3.74E-02)	2.16E-01 - (3.16E-02)	1.75E-01 (2.43E-02)
F14	2.74E-01 - (3.00E-02)	2.48E-01 - (3.10E-02)	2.72E-01 - (5.76E-02)	2.24E-01 - (3.19E-02)	2.39E-01 - (3.25E-02)	2.31E-01 - (4.01E-02)	2.22E-01 - (3.01E-02)	2.42E-01 - (2.92E-02)	**1.98E-01** (2.55E-02)
F15	5.80E+00 - (6.09E-01)	5.63E+00 - (2.63E+00)	5.45E+00 - (6.87E-01)	3.21E+00 - (4.09E-01)	3.00E+00 - (7.92E-01)	3.19E+00 - (7.73E-01)	3.33E+00 - (7.44E-01)	3.97E+00 - (7.66E-01)	**2.35E+00** (4.79E-01)
F16	9.79E+00 - (3.06E-01)	1.17E+01 - (3.44E-01)	1.12E+01 - (3.87E-01)	9.47E+00 = (3.44E-01)	**9.08E+00** + (7.92E-01)	9.41E+00 = (9.66E-01)	9.26E+00 = (6.90E-01)	1.01E+01 - (3.73E-01)	9.51E+00 (5.46E-01)
F17	1.68E+03 - (2.20E+03)	3.89E+03 - (2.19E+03)	3.42E+04 - (3.51E+04)	1.08E+03 - (3.52E+02)	1.81E+03 - (2.14E+03)	3.19E+02 = (1.85E+02)	1.14E+05 - (7.74E+04)	**2.50E+02** + (1.66E+02)	3.59E+02 (2.03E+02)
F18	1.72E+01 = (7.16E+00)	2.46E+02 - (3.44E+02)	3.38E+02 - (8.34E+02)	1.45E+02 - (3.59E+02)	**1.23E+01** + (4.70E+00)	1.33E+01 + (5.92E+00)	5.25E+02 - (6.91E+02)	1.24E+01 + (4.96E+00)	1.78E+01 (7.43E+00)
F19	4.46E+00 - (6.07E-01)	5.89E+00 - (8.30E+00)	1.31E+01 - (1.27E+00)	4.52E+00 - (6.92E-01)	2.75E+00 = (8.15E-01)	2.91E+00 - (3.36E-01)	3.32E+00 - (6.17E-01)	3.92E+00 - (6.47E-01)	**2.59E+00** (6.49E-01)
F20	1.08E+01 - (3.70E+00)	7.25E+01 - (4.04E+01)	1.14E+02 - (2.09E+02)	3.01E+03 - (3.06E+03)	1.25E+01 - (5.15E+00)	**8.61E+00** = (3.22E+00)	1.17E+01 = (7.25E+00)	9.43E+00 = (3.35E+00)	9.41E+00 (3.56E+00)
F21	2.65E+02 - (1.67E+02)	1.07E+03 - (9.00E+02)	1.00E+04 - (1.66E+04)	1.39E+03 - (7.71E+03)	1.96E+02 = (1.43E+02)	1.58E+02 = (1.22E+02)	8.13E+03 - (7.85E+03)	**8.76E+01** + (9.29E+01)	1.67E+02 (9.55E+01)
F22	1.15E+02 - (5.38E+01)	9.89E+01 - (6.66E+01)	2.50E+02 - (1.02E+02)	1.32E+02 - (7.40E+01)	1.79E+02 - (9.78E+01)	1.09E+02 - (8.74E+01)	5.21E+01 = (5.85E+01)	5.90E+01 - (5.14E+01)	**4.06E+01** (4.25E+01)
F23	3.15E+02 = (4.02E-13)	3.15E+02 = (4.02E-13)	**3.14E+02** + (1.03E-12)	3.15E+02 = (4.02E-13)	3.15E+02 = (3.73E-13)	3.15E+02 = (4.02E-13)	3.15E+02 = (4.02E-13)	3.15E+02 = (4.02E-13)	3.15E+02 (4.02E-13)
F24	2.24E+02 - (2.24E+00)	2.26E+02 - (3.59E+00)	2.30E+02 - (5.88E+00)	2.24E+02 - (1.69E+00)	2.24E+02 = (3.21E+00)	**2.23E+02** = (9.99E-01)	**2.23E+02** + (1.44E+00)	2.24E+02 - (8.99E-01)	2.24E+02 (8.57E-01)
F25	2.03E+02 = (5.18E-01)	2.08E+02 - (2.69E+00)	**2.00E+02** + (3.44E-01)	2.05E+02 - (2.05E+00)	2.03E+02 = (6.07E-01)	2.03E+02 = (4.36E-01)	2.04E+02 - (5.38E-01)	2.03E+02 + (3.38E-01)	2.03E+02 (4.08E-01)
F26	**1.00E+02** - (3.75E-02)	**1.00E+02** - (3.31E-02)	**1.00E+02** - (4.52E-02)	**1.00E+02** - (3.38E-02)	**1.00E+02** - (5.47E-02)	**1.00E+02** - (5.41E-02)	**1.00E+02** + (3.62E-02)	**1.00E+02** - (2.81E-02)	**1.00E+02** (2.51E-02)
F27	3.48E+02 = (5.03E+01)	3.72E+02 - (3.89E+01)	8.73E+02 - (3.67E+01)	3.68E+02 - (4.92E+01)	3.69E+02 - (4.44E+01)	3.89E+02 - (3.28E+01)	**3.03E+02** + (1.11E+01)	3.66E+02 = (4.73E+01)	3.44E+02 (5.00E+01)
F28	7.89E+02 + (2.34E+01)	8.69E+02 - (3.67E+01)	**3.96E+02** + (1.34E+01)	8.00E+02 = (1.89E+01)	8.36E+02 - (2.62E+01)	8.28E+02 - (2.82E+01)	7.86E+02 + (2.08E+01)	8.37E+02 - (3.53E+01)	8.02E+02 (2.45E+01)
F29	7.95E+02 - (6.99E+01)	9.13E+02 - (2.04E+02)	**2.14E+02** + (1.46E+00)	7.18E+02 = (6.90E+01)	7.68E+02 - (1.43E+02)	5.27E+02 + (2.62E+02)	1.41E+03 - (2.05E+02)	6.88E+02 + (1.24E+02)	6.19E+02 (2.11E+02)
F30	1.20E+03 - (4.47E+02)	1.86E+03 - (5.78E+02)	**5.99E+02** = (1.46E+02)	1.56E+03 - (5.17E+02)	9.35E+02 - (4.22E+02)	7.29E+02 = (2.83E+02)	1.25E+03 - (4.95E+02)	6.37E+02 = (1.99E+02)	6.38E+02 (2.36E+02)
-/=/+	**20/8/2**	**27/3/0**	**20/5/5**	**18/10/2**	**15/11/4**	**13/14/3**	**16/9/5**	**16/8/6**	

TABLE S14 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	SinDE	MPEDE	MLCCDE
F1	4.11E+05 - (1.45E+05)	3.73E+05 - (1.33E+05)	4.36E+06 + (1.13E+07)	**1.59E+04** + (8.93E+03)	2.19E+05 - (9.60E+04)	3.13E+05 - (1.10E+05)	1.99E+06 - (7.96E+05)	5.89E+04 + (3.87E+04)	1.74E+05 (5.63E+04)
F2	5.30E-09 - (1.17E-08)	2.54E+03 - (3.25E+03)	1.65E-08 - (2.51E-08)	**0.00E+00** = (0.00E+00)	3.51E+01 - (7.36E+01)	4.25E+03 - (3.98E+03)	4.28E+03 - (4.12E+03)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	1.04E+00 - (1.91E+00)	1.73E-04 - (5.77E-04)	3.74E+03 - (2.50E+03)	3.23E+01 - (6.70E+01)	2.33E-02 - (5.13E-02)	4.14E+02 - (2.71E+02)	8.34E-05 - (2.75E-04)	4.49E-04 (3.20E-03)
F4	8.18E+01 - (1.74E+01)	5.41E+01 - (3.39E+01)	3.23E+01 - (2.40E+01)	**2.02E+01** + (4.05E+01)	2.86E+01 - (3.55E+01)	5.47E+01 - (3.38E+01)	9.25E+01 - (5.65E+00)	3.77E+01 = (4.17E+01)	2.33E+01 (3.16E+01)
F5	2.04E+01 - (3.27E-02)	2.11E+01 - (3.25E-02)	2.06E+01 - (4.77E-02)	2.03E+01 - (3.04E-02)	**2.00E+01** + (4.54E-02)	2.01E+01 + (2.75E-01)	2.07E+01 - (5.80E-02)	2.05E+01 - (4.96E-02)	2.03E+01 (4.31E-02)
F6	4.56E+00 - (5.39E+00)	1.25E+01 - (2.48E+00)	4.55E+01 - (3.64E+00)	1.62E+01 - (5.06E+00)	8.93E+00 - (3.26E+00)	7.08E+00 - (3.71E+00)	**2.12E-01** + (4.48E-01)	6.35E+00 - (2.27E+00)	1.15E+00 (9.91E-01)
F7	**0.00E+00** = (0.00E+00)	7.72E-03 - (9.20E-03)	7.63E-03 - (8.90E-03)	2.17E-03 - (4.77E-03)	2.85E-03 - (4.79E-03)	7.25E-04 - (2.53E-03)	**0.00E+00** = (0.00E+00)	2.32E-03 - (4.81E-03)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	1.23E+01 - (3.97E+00)	2.15E-01 = (1.26E+00)	**0.00E+00** = (0.00E+00)	5.85E-01 - (7.49E-01)	3.51E-01 - (1.12E+00)	4.28E+00 - (2.52E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F9	9.05E+01 - (1.09E+01)	6.83E+01 - (1.34E+01)	1.45E+02 - (1.92E+01)	5.41E+01 - (7.45E+00)	7.76E+01 - (1.98E+01)	8.69E+01 - (2.41E+01)	6.36E+01 - (1.15E+01)	5.40E+01 - (1.29E+01)	**4.25E+01** (6.97E+00)
F10	**1.96E-03** + (5.22E-03)	1.03E+02 - (9.78E+01)	6.08E+02 - (5.90E+02)	8.57E-03 + (8.83E-03)	4.97E+00 = (3.21E+00)	1.15E+02 - (5.29E+01)	1.67E+01 - (7.00E+00)	5.80E-01 + (2.26E-01)	3.84E+00 (1.71E+00)
F11	5.11E+03 - (4.90E+02)	8.92E+03 - (2.07E+03)	9.09E+03 - (8.51E+02)	**3.78E+03** + (3.00E+02)	4.39E+03 - (7.64E+02)	4.40E+03 - (7.40E+02)	4.14E+03 = (7.00E+02)	5.18E+03 - (6.71E+02)	3.98E+03 (5.01E+02)
F12	5.09E-01 - (5.86E-02)	2.58E+00 - (2.43E-01)	8.42E-01 - (9.48E-02)	2.53E-01 = (3.27E-02)	9.53E-02 + (4.75E-02)	**6.77E-02** + (6.64E-02)	5.56E-01 - (1.81E-01)	5.48E-01 - (9.88E-02)	2.53E-01 (5.82E-02)
F13	3.90E-01 - (4.35E-02)	3.82E-01 - (5.98E-02)	3.75E-01 - (5.81E-02)	3.29E-01 - (4.47E-02)	3.39E-01 - (5.43E-02)	3.23E-01 - (5.94E-02)	**2.22E-01** + (3.96E-02)	2.70E-01 = (4.16E-02)	2.74E-01 (3.56E-02)
F14	3.10E-01 - (2.98E-02)	3.04E-01 - (2.96E-02)	3.32E-01 - (8.49E-02)	2.93E-01 - (3.20E-02)	2.78E-01 - (3.48E-02)	2.76E-01 - (3.46E-02)	**2.64E-01** + (1.01E-01)	3.10E-01 - (3.16E-02)	**2.64E-01** (2.84E-02)
F15	1.18E+01 - (1.32E+00)	9.03E+00 - (1.93E+00)	1.87E+01 - (2.51E+00)	7.45E+00 - (9.96E-01)	7.02E+00 - (1.44E+00)	7.11E+00 - (1.64E+00)	6.56E+00 - (1.11E+00)	6.31E+00 - (1.50E+00)	**5.16E+00** (8.50E-01)
F16	1.81E+01 = (3.98E-01)	2.12E+01 - (3.24E-01)	2.09E+01 - (4.49E-01)	**1.78E+01** + (4.71E-01)	1.82E+01 = (1.05E+00)	1.85E+01 = (1.06E+00)	1.82E+01 = (6.64E-01)	1.85E+01 - (4.69E-01)	1.81E+01 (5.78E-01)
F17	1.89E+04 - (1.20E+04)	3.58E+04 - (2.22E+04)	2.17E+05 - (1.37E+05)	2.51E+03 - (8.70E+02)	1.62E+04 - (9.33E+03)	1.15E+04 - (9.74E+03)	3.31E+05 - (1.74E+05)	**1.70E+03** + (4.64E+02)	2.16E+03 (9.57E+02)
F18	3.17E+02 - (3.75E+02)	5.12E+02 - (3.41E+02)	2.51E+03 - (3.26E+03)	1.63E+02 - (3.42E+01)	3.23E+02 - (4.03E+02)	1.86E+02 - (2.47E+02)	2.37E+02 - (3.20E+02)	1.26E+02 - (3.08E+01)	**6.17E+01** (3.24E+01)
F19	1.31E+01 - (5.08E+00)	1.73E+01 - (1.24E+01)	2.45E+01 - (1.47E+00)	1.44E+01 - (5.91E+00)	**6.05E+00** + (1.23E+00)	6.55E+00 + (9.05E-01)	9.03E+00 = (8.10E-01)	7.05E+00 + (1.10E+00)	9.31E+00 (5.96E-01)
F20	5.16E+01 - (2.12E+01)	3.09E+02 - (1.06E+02)	2.97E+02 - (3.24E+02)	5.88E+03 - (6.90E+03)	2.80E+02 - (3.44E+02)	**3.27E+01** + (1.28E+01)	4.57E+02 - (1.19E+03)	6.10E+01 - (3.05E+01)	4.08E+01 (1.23E+01)
F21	1.07E+04 - (1.09E+04)	2.00E+04 - (1.45E+04)	1.03E+05 - (8.12E+04)	4.89E+04 - (3.40E+05)	9.62E+03 - (1.18E+04)	3.74E+03 - (3.40E+03)	2.36E+05 - (1.55E+05)	7.37E+02 = (2.16E+02)	**6.42E+02** (2.04E+02)
F22	5.20E+02 - (1.73E+02)	3.38E+02 = (1.34E+02)	8.11E+02 - (1.85E+02)	4.92E+02 - (1.64E+02)	6.09E+02 - (2.20E+02)	5.21E+02 - (1.94E+02)	**2.86E+02 =** (1.55E+02)	5.66E+02 - (2.10E+02)	3.05E+02 (1.20E+02)
F23	3.44E+02 - (3.91E-13)	3.44E+02 - (4.65E-13)	**3.37E+02** + (3.52E-12)	3.44E+02 - (4.35E-13)	3.44E+02 + (2.87E-13)	3.44E+02 = (3.91E-13)	3.44E+02 - (4.27E-13)	3.44E+02 = (4.53E-13)	3.44E+02 (4.43E-13)
F24	2.68E+02 - (2.05E+00)	2.75E+02 - (3.39E+00)	2.74E+02 - (4.92E+00)	2.75E+02 - (2.12E+00)	2.71E+02 - (2.71E+00)	2.69E+02 - (2.60E+00)	2.65E+02 - (3.60E+00)	2.75E+02 - (1.99E+00)	**2.60E+02** (4.70E+00)
F25	2.07E+02 = (1.38E+00)	2.16E+02 - (9.85E+00)	**2.01E+02** + (2.41E+00)	2.22E+02 - (4.70E+00)	2.09E+02 = (4.91E+00)	2.07E+02 = (3.26E+00)	2.08E+02 - (1.65E+00)	2.08E+02 = (7.37E+00)	2.07E+02 (2.20E+00)
F26	**1.00E+02** - (4.27E-02)	1.69E+02 - (4.67E+01)	**1.00E+02** - (4.26E-02)	**1.00E+02** - (1.21E-01)	1.12E+02 - (3.24E+01)	1.04E+02 - (1.96E+01)	1.02E+02 = (1.40E+01)	**1.00E+02** = (2.96E-02)	1.02E+02 (1.40E+01)
F27	3.75E+02 - (5.11E+01)	6.45E+02 - (7.53E+01)	1.57E+03 - (4.19E+01)	4.38E+02 - (5.36E+01)	5.54E+02 - (7.53E+01)	4.43E+02 - (6.80E+01)	3.45E+02 = (1.92E+01)	4.72E+02 - (5.74E+01)	**3.35E+02** (3.35E+01)
F28	1.13E+03 = (5.00E+01)	1.27E+03 - (1.38E+02)	**3.87E+02** + (1.36E+01)	1.15E+03 = (4.03E+01)	1.19E+03 - (5.40E+01)	1.18E+03 - (5.85E+01)	1.06E+03 + (3.80E+01)	1.14E+03 = (6.61E+01)	1.14E+03 (3.80E+01)
F29	9.97E+02 - (1.45E+02)	1.09E+03 - (1.78E+02)	**2.26E+02** + (8.88E+00)	8.86E+02 - (5.90E+01)	9.40E+02 - (1.10E+02)	1.07E+03 - (2.04E+02)	2.20E+03 - (3.81E+02)	8.33E+02 - (8.62E+01)	6.76E+02 (1.52E+02)
F30	8.63E+03 + (4.02E+02)	1.03E+04 - (9.79E+02)	**1.17E+03** + (1.85E+02)	9.69E+03 - (8.05E+02)	8.97E+03 = (4.93E+02)	8.92E+03 = (4.72E+02)	8.35E+03 + (4.81E+02)	9.40E+03 - (6.93E+02)	8.95E+03 (5.68E+02)
-/=/+	**22/6/2**	**29/1/0**	**23/1/6**	**21/4/5**	**22/4/4**	**22/4/4**	**18/7/5**	**17/9/4**	

TABLE S15 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 30-DIMENSIONAL CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	SinDE	MPEDE	MLCCDE
F1	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	1.16E+00 - (7.99E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F2	2.46E-04 - (8.84E-05)	3.86E-04 - (1.67E-04)	2.83E-05 + (1.37E-05)	1.68E-05 + (8.66E-06)	1.33E-04 - (4.03E-05)	9.96E-05 - (3.78E-05)	2.49E-01 - (1.39E+00)	**1.02E-07** + (1.96E-07)	5.25E-05 (2.12E-05)
F3	4.32E-04 - (1.35E-03)	0.00E+00 = (0.00E+00)	8.32E+03 - (3.66E+04)	9.73E+03 - (1.75E+04)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	8.62E+02 - (7.15E+02)	**0.00E+00** = (0.00E+00)	4.49E-03 (3.21E-02)
F4	5.22E+01 - (2.10E+01)	1.82E+01 - (2.80E+01)	**1.17E+00** = (1.70E+00)	3.76E+01 - (2.84E+01)	3.66E+01 - (2.88E+01)	3.36E+01 - (2.96E+01)	8.46E+01 - (4.38E+00)	5.64E+01 - (1.41E+01)	2.31E+01 (2.87E+01)
F5	4.04E+01 - (5.53E+00)	2.73E+01 - (8.60E+00)	3.94E+01 - (6.98E+00)	2.63E+01 - (4.36E+00)	3.75E+01 - (1.16E+01)	4.11E+01 - (9.24E+00)	2.61E+01 - (6.21E+00)	2.83E+01 - (6.40E+00)	**2.09E+01** (4.98E+00)
F6	**0.00E+00** = (0.00E+00)	7.51E-07 - (3.31E-06)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F7	7.69E+01 - (6.24E+00)	5.76E+01 - (7.45E+00)	7.52E+01 - (6.13E+00)	5.39E+01 - (4.68E+00)	6.61E+01 - (9.94E+00)	7.06E+01 - (1.23E+01)	6.23E+01 - (7.45E+00)	5.49E+01 - (5.59E+00)	**5.06E+01** (3.43E+00)
F8	4.34E+01 - (5.50E+00)	2.97E+01 - (9.19E+00)	4.32E+01 - (6.02E+00)	2.50E+01 - (2.97E+00)	3.79E+01 - (1.05E+01)	4.27E+01 - (1.23E+01)	2.99E+01 - (7.82E+00)	2.81E+01 - (7.40E+00)	**2.27E+01** (5.25E+00)
F9	**0.00E+00** = (0.00E+00)	5.24E-01 - (6.99E-01)	1.45E-01 - (5.27E-01)	2.83E-02 - (9.16E-02)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	1.24E-02 = (6.55E-02)	**0.00E+00** (0.00E+00)
F10	2.76E+03 - (2.86E+02)	5.28E+03 - (3.49E+02)	3.68E+03 - (3.33E+02)	**1.92E+03** = (2.56E+02)	2.05E+03 = (5.24E+02)	1.97E+03 = (5.40E+02)	**1.92E+03** = (5.09E+02)	2.66E+03 - (3.64E+02)	1.93E+03 (3.75E+02)
F11	2.53E+01 - (2.43E+01)	5.21E+01 - (2.62E+01)	2.50E+01 - (1.40E+01)	3.04E+01 - (2.40E+01)	2.00E+01 - (1.59E+01)	2.13E+01 - (1.91E+01)	2.58E+01 - (2.70E+01)	2.48E+01 - (1.42E+01)	**8.61E+00** (1.19E+01)
F12	8.71E+03 - (4.86E+03)	8.69E+03 - (5.06E+03)	2.63E+04 - (3.45E+04)	2.23E+03 + (2.02E+03)	6.37E+03 - (5.57E+03)	6.83E+03 - (7.33E+03)	6.41E+04 - (8.27E+04)	**1.05E+03** + (4.66E+02)	2.87E+03 (2.46E+03)
F13	2.66E+01 = (9.10E+00)	4.94E+03 - (5.30E+03)	1.88E+03 - (6.34E+03)	4.64E+01 - (3.49E+01)	3.18E+01 = (1.81E+01)	2.62E+01 = (1.10E+01)	3.39E+03 - (3.00E+03)	**2.22E+01** + (8.67E+00)	2.76E+01 (8.70E+00)
F14	2.46E+01 = (9.82E+00)	9.81E+01 - (3.30E+01)	7.19E+01 - (4.34E+01)	2.08E+03 - (6.38E+03)	1.57E+01 + (8.45E+00)	**1.27E+01** + (7.80E+00)	2.52E+01 = (9.03E+00)	1.61E+01 + (9.86E+00)	2.33E+01 (9.90E+00)
F15	1.10E+01 - (5.25E+00)	1.21E+02 - (5.84E+01)	1.39E+02 - (2.01E+02)	3.85E+02 - (1.79E+03)	1.12E+01 - (4.53E+00)	8.34E+00 = (3.80E+00)	3.98E+01 - (1.85E+02)	**7.54E+00** = (2.59E+00)	8.82E+00 (5.13E+00)
F16	4.44E+02 - (1.35E+02)	2.56E+02 = (1.79E+02)	6.15E+02 - (1.60E+02)	4.29E+02 - (1.37E+02)	5.26E+02 - (2.06E+02)	4.00E+02 - (1.81E+02)	**1.53E+02** + (1.33E+02)	3.84E+02 - (1.91E+02)	2.25E+02 (1.18E+02)
F17	8.88E+01 - (2.30E+01)	5.85E+01 - (3.27E+01)	1.82E+02 - (7.32E+01)	7.99E+01 - (3.06E+01)	7.38E+01 = (7.70E+01)	4.90E+01 - (4.68E+01)	3.01E+01 = (2.08E+01)	5.60E+01 - (2.86E+01)	**2.78E+01** (1.28E+01)
F18	5.06E+01 - (4.19E+01)	1.33E+03 - (2.83E+03)	1.58E+03 - (1.61E+03)	1.98E+04 - (4.81E+04)	9.09E+01 - (1.08E+02)	**1.87E+01** + (9.55E+00)	3.73E+04 - (2.16E+04)	2.44E+01 + (5.38E+00)	2.75E+01 (5.99E+00)
F19	1.09E+01 - (3.13E+00)	7.21E+01 - (3.49E+01)	3.14E+01 - (3.00E+01)	5.38E+02 - (2.40E+03)	6.23E+00 + (2.22E+00)	**4.90E+00** + (1.70E+00)	7.78E+00 = (3.50E+00)	7.54E+00 = (2.48E+00)	8.15E+00 (3.18E+00)
F20	7.52E+01 - (3.26E+01)	4.97E+01 = (5.31E+01)	1.36E+02 - (5.50E+01)	9.54E+01 - (5.53E+01)	9.74E+01 - (8.32E+01)	5.64E+01 = (7.02E+01)	3.43E+01 = (4.51E+01)	5.65E+01 - (4.28E+01)	**2.60E+01** (2.86E+01)
F21	2.43E+02 - (6.46E+00)	2.31E+02 - (8.81E+00)	2.48E+02 - (7.62E+00)	2.27E+02 - (4.18E+00)	2.39E+02 - (9.58E+00)	2.42E+02 - (1.18E+01)	2.31E+02 - (8.10E+00)	2.29E+02 - (8.29E+00)	**2.22E+02** (4.42E+00)
F22	**1.00E+02** = (9.20E-14)	**1.00E+02** - (3.44E-01)	1.86E+03 - (1.95E+03)	**1.00E+02** = (1.00E-13)	1.28E+02 = (1.98E+02)	**1.00E+02** - (2.34E-13)	**1.00E+02** = (1.37E-13)	**1.00E+02** = (1.00E-13)	**1.00E+02** (1.00E-13)
F23	3.88E+02 - (6.14E+00)	3.76E+02 - (1.13E+01)	3.96E+02 - (8.61E+00)	3.73E+02 - (5.13E+00)	3.87E+02 - (1.33E+01)	3.88E+02 - (1.15E+01)	3.76E+02 - (7.85E+00)	3.80E+02 - (9.09E+00)	**3.66E+02** (6.93E+00)
F24	4.57E+02 - (6.80E+00)	4.47E+02 - (7.92E+00)	4.67E+02 - (7.63E+00)	**4.39E+02** = (5.42E+00)	4.59E+02 - (1.22E+01)	4.62E+02 - (1.19E+01)	4.46E+02 - (7.19E+00)	4.46E+02 - (7.92E+00)	**4.39E+02** (5.41E+00)
F25	3.87E+02 = (1.62E-01)	3.87E+02 - (1.81E+00)	**3.79E+02** + (7.39E-01)	3.87E+02 - (2.08E-01)	3.87E+02 = (1.24E-01)	3.87E+02 + (6.72E-01)	3.87E+02 = (1.19E-01)	3.87E+02 + (7.77E-02)	3.87E+02 (1.41E-01)
F26	1.32E+03 - (8.19E+01)	1.26E+03 - (1.84E+02)	1.22E+03 - (1.39E+02)	1.18E+03 - (7.41E+01)	1.35E+03 - (2.17E+02)	1.38E+03 - (2.66E+02)	1.17E+03 - (7.44E+01)	1.21E+03 - (8.82E+01)	**1.12E+03** (6.94E+01)
F27	5.02E+02 = (5.73E+00)	5.08E+02 - (8.38E+00)	5.00E+02 = (8.07E-05)	5.03E+02 - (6.09E+00)	5.01E+02 = (7.34E+00)	**4.99E+02** = (1.01E+01)	**4.99E+02** = (6.13E+00)	5.02E+02 = (7.31E+00)	5.00E+02 (6.73E+00)
F28	3.34E+02 - (5.28E+01)	3.32E+02 - (5.11E+01)	4.99E+02 - (3.03E+00)	3.29E+02 - (5.00E+01)	3.23E+02 = (4.50E+01)	3.19E+02 - (4.17E+01)	3.52E+02 - (5.37E+01)	3.38E+02 - (5.56E+01)	**3.13E+02** (3.48E+01)
F29	4.90E+02 - (3.60E+01)	4.76E+02 - (4.55E+01)	5.02E+02 - (8.32E+01)	4.74E+02 - (2.50E+01)	4.47E+02 = (5.63E+01)	**4.32E+02** + (3.79E+01)	**4.32E+02** + (2.26E+01)	4.53E+02 - (3.07E+01)	4.42E+02 (2.17E+01)
F30	2.14E+03 = (1.38E+02)	3.21E+03 - (1.92E+03)	**2.23E+02** + (1.14E+01)	2.12E+03 = (1.21E+02)	2.14E+03 = (1.53E+02)	2.07E+03 = (1.10E+02)	4.23E+03 - (1.27E+03)	2.02E+03 + (9.14E+01)	2.10E+03 (1.07E+02)
-/=/+	**21/9/0**	**26/4/0**	**23/4/3**	**22/6/2**	**15/13/2**	**15/10/5**	**18/10/2**	**15/8/7**	

TABLE S16 PERFORMANCE COMPARISONS OF MLCCDE WITH STATE-OF-THE-ART AND UP-TO-DATE DE VARIANTS ON 50-DIMENSIONAL CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	jDE	SaDE	EPSDE	JADE	CoDE	CoBiDE	SinDE	MPEDE	MLCCDE
F1	3.16E-08 - (4.72E-08)	1.46E+03 - (1.74E+03)	2.50E-08 - (1.11E-07)	**0.00E+00** = (0.00E+00)	4.68E+01 - (1.02E+02)	2.61E+03 - (3.83E+03)	3.78E+03 - (4.72E+03)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F2	7.76E-04 - (2.03E-04)	9.71E-04 - (2.86E-04)	8.23E-05 + (5.93E-05)	**4.59E-05** + (1.35E-05)	4.81E-04 - (1.20E-04)	4.62E-04 - (1.18E-04)	2.02E+00 - (8.18E+00)	6.68E-05 + (3.42E-05)	2.66E-04 (9.34E-05)
F3	2.07E+02 - (3.61E+02)	1.17E-03 - (3.86E-03)	6.72E+04 - (1.35E+05)	1.66E+04 + (3.65E+04)	**1.01E-09** + (5.39E-09)	2.29E-08 + (5.74E-08)	1.63E+04 - (3.86E+03)	8.20E-05 + (3.16E-04)	7.31E-06 (1.12E-05)
F4	7.47E+01 - (4.29E+01)	9.16E+01 - (4.33E+01)	3.01E+01 = (1.85E+01)	**3.23E+01** = (4.18E+01)	5.08E+01 = (4.53E+01)	6.93E+01 - (4.72E+01)	5.81E+01 - (4.97E+01)	5.62E+01= (4.82E+01)	5.05E+01 (4.62E+01)
F5	9.01E+01 - (1.11E+01)	7.39E+01 - (1.54E+01)	1.51E+02 - (1.59E+01)	5.52E+01 - (6.99E+00)	7.79E+01 - (1.71E+01)	8.54E+01 - (1.92E+01)	6.22E+01 - (1.40E+01)	5.52E+01 - (1.39E+01)	**4.45E+01** (8.54E+00)
F6	**0.00E+00** + (0.00E+00)	8.29E-03 - (1.47E-02)	**0.00E+00** + (0.00E+00)	**0.00E+00** + (0.00E+00)	1.11E-06 = (7.44E-06)	7.50E-09 + (5.35E-08)	**0.00E+00** + (0.00E+00)	2.14E-03 - (5.23E-03)	7.43E-08 (3.21E-07)
F7	1.50E+02 - (1.04E+01)	1.23E+02 - (1.68E+01)	2.07E+02 - (1.66E+01)	1.02E+02 - (7.31E+00)	1.30E+02 - (1.52E+01)	1.34E+02 - (1.88E+01)	1.18E+02 - (1.44E+01)	1.09E+02 - (1.48E+01)	**9.19E+01** (8.55E+00)
F8	9.08E+01 - (1.03E+01)	7.48E+01 - (1.46E+01)	1.52E+02 - (1.76E+01)	5.53E+01 - (7.91E+00)	7.63E+01 - (1.92E+01)	8.83E+01 - (1.57E+01)	6.28E+01 - (1.26E+01)	5.24E+01 = (1.36E+01)	**4.79E+01** (6.52E+00)
F9	3.36E-02 + (9.59E-02)	2.11E+01 - (1.52E+01)	3.65E+00 = (1.51E+01)	1.97E+00 - (1.49E+00)	5.37E+00 - (7.12E+00)	1.15E-01 = (1.93E-01)	**0.00E+00** + (0.00E+00)	1.17E+00 - (1.24E+00)	1.08E-01 (1.92E-01)
F10	5.13E+03 - (3.43E+02)	8.65E+03 - (2.15E+03)	8.82E+03 - (5.24E+02)	**3.71E+03** + (2.97E+02)	4.44E+03 - (7.89E+02)	4.31E+03 - (9.00E+02)	4.13E+03 - (6.49E+02)	4.84E+03 - (6.98E+02)	3.86E+03 (5.44E+02)
F11	5.05E+01 - (1.06E+01)	1.31E+02 - (4.81E+01)	7.79E+01 - (5.20E+01)	1.40E+02 - (3.40E+01)	5.71E+01 - (1.39E+01)	5.79E+01 - (1.58E+01)	3.85E+01 = (3.60E+00)	1.04E+02 - (2.24E+01)	**3.80E+01** (6.29E+00)
F12	5.01E+04 - (3.12E+04)	3.04E+04 - (1.79E+04)	1.77E+05 - (1.17E+05)	**5.95E+03** + (3.37E+03)	3.76E+04 - (1.85E+04)	6.54E+04 - (3.09E+04)	8.64E+05 - (6.01E+05)	9.48E+03 + (6.65E+03)	1.93E+04 (1.62E+04)
F13	2.07E+03 - (2.07E+03)	2.16E+03 - (2.97E+03)	8.73E+03 - (1.72E+04)	2.88E+02 - (1.80E+02)	3.74E+03 - (4.44E+03)	3.44E+03 - (4.60E+03)	1.96E+03 - (2.07E+03)	**9.05E+01** = (4.07E+01)	1.16E+02 (1.17E+02)
F14	6.00E+01 = (1.78E+01)	7.90E+02 - (6.90E+02)	1.57E+03 - (3.01E+03)	7.88E+03 - (3.98E+04)	7.52E+01 - (7.11E+01)	**5.07E+01** = (1.20E+01)	9.87E+03 - (1.74E+04)	6.21E+01 - (1.40E+01)	5.42E+01 (1.01E+01)
F15	9.91E+01 = (1.68E+02)	2.40E+03 - (2.10E+03)	3.03E+03 - (6.89E+03)	2.80E+02 - (1.22E+02)	1.47E+02 - (1.48E+02)	7.44E+01 - (5.57E+01)	1.25E+03 - (1.26E+03)	7.98E+01 - (4.38E+01)	**4.97E+01** (1.26E+01)
F16	9.96E+02 - (1.54E+02)	7.39E+02 = (2.51E+02)	1.21E+03 - (2.85E+02)	7.81E+02 - (1.61E+02)	1.10E+03 - (2.71E+02)	1.00E+03 - (3.17E+02)	7.33E+02 = (2.79E+02)	9.04E+02 - (2.92E+02)	**6.44E+02** (2.10E+02)
F17	7.09E+02 - (1.37E+02)	4.43E+02 = (1.77E+02)	8.63E+02 - (1.85E+02)	6.45E+02 - (1.31E+02)	7.29E+02 - (2.28E+02)	6.01E+02 - (2.21E+02)	**3.41E+02** + (1.77E+02)	5.78E+02 - (1.93E+02)	4.24E+02 (1.09E+02)
F18	2.26E+03 - (2.76E+03)	1.77E+04 - (1.69E+04)	6.71E+03 - (6.14E+03)	1.70E+02 - (7.33E+01)	3.52E+03 - (2.95E+03)	1.91E+03 - (1.37E+03)	2.68E+05 - (2.53E+05)	1.38E+02 = (1.09E+02)	**7.78E+01** (7.43E+01)
F19	2.93E+01 = (1.29E+01)	9.06E+03 - (5.89E+03)	2.68E+02 - (5.40E+02)	3.81E+02 - (1.67E+03)	3.87E+01 = (7.19E+01)	2.99E+01 = (2.12E+01)	7.65E+03 - (5.67E+03)	4.87E+01 - (1.75E+01)	**2.68E+01** (5.42E+00)
F20	4.96E+02 - (1.25E+02)	**2.26E+02** = (1.71E+02)	6.55E+02 - (1.58E+02)	4.78E+02 - (1.44E+02)	5.03E+02 - (2.03E+02)	3.92E+02 - (1.71E+02)	2.29E+02 = (1.64E+02)	3.92E+02 - (1.98E+02)	2.38E+02 (1.06E+02)
F21	2.93E+02 - (9.17E+00)	2.64E+02 - (1.41E+01)	3.47E+02 - (1.47E+01)	2.54E+02 - (7.47E+00)	2.76E+02 - (1.61E+01)	2.87E+02 - (2.17E+01)	2.64E+02 - (1.25E+01)	2.48E+02 = (1.22E+01)	**2.44E+02** (7.32E+00)
F22	3.29E+03 - (2.70E+03)	5.60E+03 - (3.92E+03)	9.48E+03 - (5.22E+02)	3.26E+03 = (1.86E+03)	4.81E+03 - (1.26E+03)	4.19E+03 - (1.33E+03)	3.72E+03 = (1.68E+03)	**1.97E+03** = (2.48E+03)	2.56E+03 (2.28E+03)
F23	5.11E+02 - (1.39E+01)	4.93E+02 - (1.82E+01)	5.60E+02 - (3.10E+01)	4.79E+02 - (1.12E+01)	5.03E+02 - (2.19E+01)	5.21E+02 - (2.25E+01)	4.75E+02 - (1.45E+01)	4.73E+02 - (1.39E+01)	**4.65E+02** (8.39E+00)
F24	5.75E+02 - (1.35E+01)	5.61E+02 - (1.73E+01)	6.42E+02 - (2.23E+01)	5.42E+02 - (9.56E+00)	5.72E+02 - (1.88E+01)	5.82E+02 - (2.03E+01)	5.51E+02 - (1.15E+01)	5.42E+02 - (1.37E+01)	**5.33E+02** (7.30E+00)
F25	5.11E+02 = (3.70E+01)	5.52E+02 - (4.00E+01)	**4.51E+02** + (2.05E+01)	5.25E+02 = (3.58E+01)	5.16E+02 = (3.64E+01)	5.13E+02 = (2.90E+01)	4.91E+02 + (2.70E+01)	5.17E+02 = (3.26E+01)	5.28E+02 (3.71E+01)
F26	1.94E+03 - (1.05E+02)	1.97E+03 - (2.08E+02)	2.60E+03 - (4.40E+02)	1.60E+03 - (9.98E+01)	1.95E+03 - (2.07E+02)	2.04E+03 - (2.70E+02)	1.67E+03 - (1.34E+02)	1.55E+03 - (1.48E+02)	**1.47E+03** (1.04E+02)
F27	5.33E+02 = (1.81E+01)	6.04E+02 - (4.65E+01)	**5.00E+02** + (9.74E-05)	5.62E+02 - (2.55E+01)	5.38E+02 - (1.91E+01)	5.43E+02 - (2.60E+01)	5.12E+02 + (7.70E+00)	5.51E+02 - (2.73E+01)	5.30E+02 (1.05E+01)
F28	4.85E+02 - (2.43E+01)	5.00E+02 - (1.87E+01)	5.00E+02 = (1.03E-04)	4.96E+02 - (1.79E+01)	4.88E+02 = (2.76E+01)	4.80E+02 - (2.36E+01)	**4.65E+02** = (1.59E+01)	4.88E+02 = (2.27E+01)	4.85E+02 (2.40E+01)
F29	4.92E+02 - (7.63E+01)	5.97E+02 - (1.34E+02)	9.70E+02 - (1.81E+02)	4.75E+02 - (7.31E+01)	5.74E+02 - (1.73E+02)	5.81E+02 - (1.82E+02)	**3.47E+02** + (1.86E+01)	4.40E+02 = (1.16E+02)	3.95E+02 (4.31E+01)
F30	6.05E+05 - (2.73E+04)	6.35E+05 - (7.54E+04)	**1.50E+03** + (2.07E+03)	6.44E+05 - (5.66E+04)	5.97E+05 = (2.28E+04)	6.03E+05 - (2.71E+04)	6.65E+05 - (5.26E+04)	6.85E+05 - (1.05E+05)	5.95E+05 (2.57E+04)
-/=/+	**23/5/2**	**27/3/0**	**22/3/5**	**21/4/5**	**23/6/1**	**24/4/2**	**19/5/6**	**17/10/3**	

TABLE S17 PERFORMANCE COMPARISONS OF MLCC-SIBI WITH SHADE, IDE AND BIDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30				*D* = 50			
	SHADE	IDE	BiDE	MLCC-SIBi	SHADE	IDE	BiDE	MLCC-SIBi
F1	**2.59E+02** + (5.67E+02)	1.18E+05 - (9.41E+04)	3.00E+02 + (6.19E+02)	1.11E+03 (2.29E+03)	**1.19E+05** = (6.14E+04)	1.24E+06 - (3.41E+05)	1.55E+05 = (8.27E+04)	1.39E+05 (7.09E+04)
F2	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.28E+00 - (2.53E+00)	5.06E-04 - (5.12E-04)	**0.00E+00** (0.00E+00)
F3	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	1.85E+01 - (1.27E+01)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F4	**0.00E+00** = (0.00E+00)	2.08E-02 - (4.14E-02)	2.57E-08 - (4.92E-08)	**0.00E+00** (0.00E+00)	8.35E+01 - (1.16E+01)	7.19E+01 - (2.97E+01)	3.32E+01 = (3.64E+01)	**2.29E+01** (2.95E+01)
F5	2.03E+01 - (3.54E-02)	2.02E+01 - (5.68E-02)	**2.01E+01** = (1.22E-01)	**2.01E+01** (6.26E-02)	2.05E+01 - (4.03E-02)	**2.03E+01** = (5.95E-02)	2.07E+01 - (8.52E-02)	**2.03E+01** (5.74E-02)
F6	6.41E+00 - (3.86E+00)	**6.20E-02** + (2.82E-01)	5.74E-01 = (8.99E-01)	5.89E-01 (1.30E+00)	1.18E+00 = (3.45E+00)	**9.34E-02** + (3.14E-01)	6.35E+00 - (1.01E+01)	5.23E-01 (6.94E-01)
F7	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	2.22E-03 - (4.10E-03)	**0.00E+00** = (0.00E+00)	**0.00E+00** (0.00E+00)
F8	**0.00E+00** = (0.00E+00)	4.33E-10 = (3.09E-09)	2.14E-03 - (3.25E-03)	**0.00E+00** (0.00E+00)	1.84E-02 - (5.39E-03)	4.32E-02 - (1.97E-01)	5.98E+01 - (4.25E+00)	**7.17E-06** (2.34E-05)
F9	2.75E+01 = (4.18E+00)	**2.46E+01** + (5.33E+00)	3.18E+01 = (7.22E+00)	2.96E+01 (8.33E+00)	8.82E+01 - (8.25E+00)	**5.99E+01** = (1.01E+01)	1.99E+02 - (3.82E+01)	6.08E+01 (1.25E+01)
F10	**1.57E-01** + (3.94E-02)	5.68E+00 - (1.66E+01)	1.20E+02 - (2.69E+01)	1.19E+00 (8.50E-01)	6.06E+01 - (6.43E+00)	3.34E+01 + (4.90E+01)	2.36E+03 - (3.27E+02)	**1.77E+01** (5.89E+00)
F11	1.97E+03 - (2.06E+02)	1.92E+03 - (3.53E+02)	**1.59E+03** = (4.02E+02)	1.77E+03 (4.09E+02)	6.27E+03 - (3.93E+02)	4.20E+03 = (6.65E+02)	7.96E+03 - (1.40E+03)	**4.13E+03** (6.75E+02)
F12	3.08E-01 - (4.82E-02)	2.91E-01 - (5.97E-02)	1.61E-01 = (8.44E-02)	**1.54E-01** (7.49E-02)	6.12E-01 - (6.73E-02)	3.68E-01 - (7.37E-02)	1.02E+00 - (2.76E-01)	**3.24E-01** (6.51E-02)
F13	2.15E-01 - (2.58E-02)	**1.87E-01** = (2.20E-02)	2.08E-01 - (4.34E-02)	**1.87E-01** (3.31E-02)	3.01E-01 = (2.99E-02)	2.96E-01 = (3.09E-02)	2.95E-01 = (5.23E-02)	**2.93E-01** (3.13E-02)
F14	2.14E-01 - (2.24E-02)	**1.82E-01** = (3.19E-02)	2.14E-01 - (2.89E-02)	1.92E-01 (2.40E-02)	**2.50E-01** + (1.82E-02)	2.70E-01 = (2.23E-02)	2.52E-01 = (3.45E-02)	2.64E-01 (2.49E-02)
F15	3.83E+00 - (4.70E-01)	2.69E+00 = (5.27E-01)	3.18E+00 - (8.94E-01)	**2.65E+00** (6.60E-01)	1.18E+01 - (8.02E-01)	7.36E+00 = (1.93E+00)	1.97E+01 - (3.82E+00)	**6.72E+00** (1.66E+00)
F16	9.55E+00 = (3.49E-01)	1.00E+01 - (3.94E-01)	**9.36E+00** = (5.31E-01)	9.42E+00 (5.25E-01)	1.88E+01 - (2.77E-01)	1.92E+01 - (4.21E-01)	2.02E+01 - (6.30E-01)	**1.86E+01** (5.34E-01)
F17	7.62E+02 - (3.58E+02)	5.97E+02 - (2.97E+02)	2.12E+02 = (1.38E+02)	**1.64E+02** (1.15E+02)	2.21E+03 - (5.57E+02)	7.22E+03 - (2.74E+03)	1.38E+03 - (5.57E+02)	**9.64E+02** (2.70E+02)
F18	1.44E+01 - (7.28E+00)	1.90E+01 - (5.87E+00)	**8.57E+00** + (3.34E+00)	1.09E+01 (5.33E+00)	8.03E+01 - (2.31E+01)	3.93E+01 - (1.09E+01)	5.25E+01 - (2.42E+01)	**3.46E+01** (9.37E+00)
F19	4.01E+00 - (6.47E-01)	2.91E+00 - (4.69E-01)	2.62E+00 = (6.55E-01)	**2.48E+00** (4.62E-01)	1.29E+01 - (5.85E+00)	1.03E+01 = (7.50E-01)	1.14E+01 - (7.45E-01)	**1.02E+01** (4.92E-01)
F20	**4.96E+00** + (2.19E+00)	1.08E+01 - (3.24E+00)	8.37E+00 - (2.35E+00)	6.35E+00 (2.17E+00)	4.11E+01 - (1.63E+01)	4.54E+01 - (1.04E+01)	3.31E+01 - (9.20E+00)	**2.49E+01** (5.62E+00)
F21	1.29E+02 - (8.62E+01)	3.30E+02 - (1.54E+02)	1.28E+02 = (1.16E+02)	**1.01E+02** (7.61E+01)	9.75E+02 - (2.81E+02)	1.23E+03 - (3.77E+02)	8.62E+02 - (2.94E+02)	**4.88E+02** (1.82E+02)
F22	1.23E+02 - (5.85E+01)	7.30E+01 = (5.78E+01)	9.45E+01 - (8.43E+01)	**6.07E+01** (5.41E+01)	4.85E+02 - (1.22E+02)	3.04E+02 = (1.06E+02)	3.86E+02 - (1.51E+02)	**3.03E+02** (1.41E+02)
F23	**3.15E+02** = (4.02E-13)	**3.15E+02** + (3.46E-13)	**3.15E+02** = (4.02E-13)	**3.15E+02** (4.02E-13)	**3.44E+02** = (4.60E-13)	**3.44E+02** = (4.46E-13)	**3.44E+02** - (4.12E-13)	**3.44E+02** (4.43E-13)
F24	2.23E+02 = (9.22E-01)	2.23E+02 - (7.24E-01)	**2.20E+02** + (6.75E+00)	2.23E+02 (7.64E-01)	2.69E+02 - (1.90E+00)	**2.58E+02** + (3.39E+00)	2.68E+02 - (1.76E+00)	2.59E+02 (2.86E+00)
F25	2.04E+02 - (7.68E-01)	**2.03E+02** - (2.33E-01)	**2.03E+02** + (2.16E-01)	**2.03E+02** (2.67E-01)	2.11E+02 - (2.59E+00)	2.07E+02 - (6.05E-01)	**2.05E+02** + (3.66E-01)	2.06E+02 (5.00E-01)
F26	**1.00E+02** - (2.79E-02)	**1.00E+02** = (2.60E-02)	**1.00E+02** = (4.89E-02)	**1.00E+02** (2.87E-02)	**1.00E+02** - (3.37E-02)	1.06E+02 = (2.37E+01)	**1.00E+02** - (5.58E-02)	**1.00E+02** (3.28E-02)
F27	**3.00E+02** + (1.11E-13)	3.30E+02 + (4.63E+01)	3.19E+02 + (3.86E+01)	3.75E+02 (4.42E+01)	3.33E+02 = (2.79E+01)	**3.06E+02** + (1.65E+01)	3.38E+02 = (2.77E+01)	3.28E+02 (3.26E+01)
F28	7.92E+02 + (1.86E+01)	8.26E+02 - (8.10E+01)	**7.88E+02** + (3.63E+01)	8.04E+02 (4.08E+01)	**1.09E+03** + (3.20E+01)	1.28E+03 - (9.49E+01)	1.16E+03 = (7.13E+01)	1.14E+03 (4.97E+01)
F29	7.20E+02 - (6.01E+00)	**5.75E+02** = (2.15E+02)	7.16E+02 = (1.54E+00)	7.07E+02 (7.88E+01)	8.27E+02 - (5.63E+01)	1.03E+03 - (1.26E+02)	7.64E+02 - (4.63E+01)	**5.42E+02** (9.93E+01)
F30	1.22E+03 - (4.61E+02)	**5.18E+02** = (7.28E+01)	7.30E+02 - (3.02E+02)	5.30E+02 (1.44E+02)	8.45E+03 - (4.59E+02)	9.90E+03 - (5.82E+02)	**8.21E+03** = (2.49E+02)	8.30E+03 (3.19E+02)
-/=/+	**16/9/5**	**15/11/4**	**9/15/6**		**20/8/2**	**16/10/4**	**20/9/1**	

TABLE S18 PERFORMANCE COMPARISONS OF MLCC-L-SI WITH L-SHADE AND M_IDE ON 30- AND 50-DIMENSIONAL CEC2014 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	D = 30			*D* = 50		
	L-SHADE	M_IDE	MLCC-L-SI	L-SHADE	M_IDE	MLCC-L-SI
F1	**0.00E+00** = (0.00E+00)	3.04E+03 - (3.66E+03)	**0.00E+00** (0.00E+00)	**8.72E+02** + (1.04E+03)	1.75E+05 - (7.85E+04)	2.32E+03 (2.68E+03)
F2	0.00E+00 = (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	**0.00E+00** = (0.00E+00)	6.99E-07 - (1.24E-06)	**0.00E+00** (0.00E+00)
F3	0.00E+00 = (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	**0.00E+00** = (0.00E+00)	2.61E-06 - (9.25E-06)	**0.00E+00** (0.00E+00)
F4	0.00E+00 = (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	5.90E+01 = (4.53E+01)	**2.12E+01** + (2.97E+01)	6.73E+01 (4.41E+01)
F5	**2.01E+01** = (2.45E-02)	2.03E+01 - (8.07E-02)	**2.01E+01** (4.58E-02)	**2.03E+01** = (2.94E-02)	2.05E+01 - (3.81E-02)	**2.03E+01** (7.23E-02)
F6	1.93E-02 = (1.38E-01)	9.12E-01 - (7.51E-01)	**0.00E+00** (0.00E+00)	1.78E-01 + (4.74E-01)	4.12E+00 - (1.73E+00)	**1.29E-01** (3.69E-01)
F7	**0.00E+00** = (0.00E+00)	5.35E-03 - (1.02E-02)	**0.00E+00** (0.00E+00)	**0.00E+00** = (0.00E+00)	6.08E-03 - (7.58E-03)	**0.00E+00** (0.00E+00)
F8	0.00E+00 = (0.00E+00)	0.00E+00 = (0.00E+00)	0.00E+00 (0.00E+00)	3.38E-08 - (3.93E-08)	3.78E+00 - (1.01E+00)	**3.05E-10** (2.18E-09)
F9	7.82E+00 = (1.65E+00)	1.81E+01 - (2.73E+00)	**7.46E+00** (1.58E+00)	1.26E+01 = (2.55E+00)	4.93E+01 - (5.35E+00)	**1.20E+01** (2.21E+00)
F10	6.12E-03 - (9.58E-03)	1.19E-05 - (4.53E-05)	**0.00E+00** (0.00E+00)	1.80E-01 - (5.96E-02)	9.15E+00 - (5.96E+00)	**1.13E-01** (3.36E-02)
F11	**1.21E+03** = (2.47E+02)	1.96E+03 - (2.55E+02)	**1.21E+03** (2.34E+02)	3.34E+03 = (2.97E+02)	5.59E+03 - (3.06E+02)	**3.25E+03** (3.51E+02)
F12	**1.70E-01** = (3.15E-02)	3.42E-01 - (4.39E-02)	1.77E-01 (2.76E-02)	2.45E-01 = (3.31E-02)	5.19E-01 - (4.42E-02)	**2.34E-01** (3.58E-02)
F13	**1.18E-01** = (1.68E-02)	1.75E-01 - (2.87E-02)	1.21E-01 (1.68E-02)	**1.60E-01** + (1.69E-02)	3.04E-01 - (3.52E-02)	1.71E-01 (1.83E-02)
F14	2.21E-01 = (3.32E-02)	**1.99E-01** + (2.71E-02)	2.21E-01 (3.15E-02)	3.20E-01 - (5.12E-02)	**2.84E-01** = (2.39E-02)	2.86E-01 (2.69E-02)
F15	2.22E+00 = (2.31E-01)	3.43E+00 - (3.48E-01)	**2.15E+00** (2.29E-01)	5.38E+00 - (4.31E-01)	9.86E+00 - (8.76E-01)	**4.95E+00** (4.76E-01)
F16	**8.52E+00** + (4.14E-01)	9.62E+00 - (3.22E-01)	8.68E+00 (4.53E-01)	**1.68E+01** = (5.06E-01)	1.83E+01 - (3.45E-01)	1.69E+01 (5.18E-01)
F17	2.47E+02 - (1.22E+02)	**1.30E+02** + (9.60E+01)	1.67E+02 (9.03E+01)	1.69E+03 - (4.27E+02)	**8.00E+02** + (3.66E+02)	1.51E+03 (4.29E+02)
F18	7.73E+00 - (4.33E+00)	1.10E+01 - (3.88E+00)	**5.08E+00** (1.80E+00)	9.75E+01 - (1.40E+01)	**4.11E+01** + (2.13E+01)	9.03E+01 (1.83E+01)
F19	3.85E+00 - (5.69E-01)	3.79E+00 = (5.23E-01)	**3.58E+00** (6.17E-01)	**8.05E+00** + (1.68E+00)	1.65E+01 - (1.01E+01)	9.97E+00 (1.33E+00)
F20	3.00E+00 = (1.26E+00)	6.69E+00 - (1.94E+00)	**2.91E+00** (1.12E+00)	**1.39E+01** = (4.15E+00)	2.28E+01 - (6.37E+00)	**1.39E+01** (3.82E+00)
F21	1.10E+02 = (7.05E+01)	1.08E+02 = (8.67E+01)	**9.34E+01** (7.87E+01)	5.59E+02 - (1.55E+02)	**4.16E+02** = (1.25E+02)	4.62E+02 (1.32E+02)
F22	**2.40E+01** = (3.95E+00)	1.58E+02 - (4.18E+01)	2.86E+01 (1.81E+01)	**9.54E+01** + (8.11E+01)	4.60E+02 - (1.10E+02)	1.36E+02 (7.05E+01)
F23	3.15E+02 = (4.02E-13)	3.15E+02 = (4.02E-13)	3.15E+02 (4.02E-13)	3.44E+02 + (3.32E-13)	3.44E+02 - (3.97E-13)	3.44E+02 (4.41E-13)
F24	2.25E+02 - (2.16E+00)	2.24E+02 - (1.02E+00)	**2.23E+02** (1.19E+00)	2.75E+02 - (7.97E-01)	**2.60E+02** + (6.34E+00)	2.69E+02 (5.26E+00)
F25	**2.03E+02** = (4.10E-02)	2.04E+02 - (1.75E+00)	**2.03E+02** (1.19E-01)	**2.05E+02** - (3.03E-01)	2.13E+02 - (8.42E+00)	**2.05E+02** (2.79E-01)
F26	1.00E+02 + (1.48E-02)	1.00E+02 - (2.71E-02)	1.00E+02 (1.87E-02)	**1.00E+02** = (1.66E-02)	1.37E+02 - (4.87E+01)	**1.00E+02** (1.76E-02)
F27	**3.00E+02** + (1.29E-13)	3.27E+02 - (3.51E+01)	**3.00E+02** (3.32E-13)	3.44E+02 - (2.84E+01)	4.14E+02 - (3.90E+01)	**3.25E+02** (3.06E+01)
F28	8.52E+02 - (1.05E+01)	**8.26E+02** - (1.13E+02)	8.33E+02 (1.24E+01)	**1.12E+03** = (3.90E+01)	1.43E+03 - (2.00E+02)	1.13E+03 (3.39E+01)
F29	7.16E+02 - (2.84E+00)	**2.95E+02** + (2.17E+02)	7.16E+02 (5.86E+00)	8.01E+02 - (2.62E+01)	5.69E+02 = (1.93E+02)	**5.13E+02** (8.26E+01)
F30	2.03E+03 = (7.46E+02)	**4.76E+02** + (1.01E+02)	1.90E+03 (8.31E+02)	8.72E+03 = (3.68E+02)	1.00E+04 - (5.36E+02)	**8.58E+03** (3.44E+02)
-/=/+	**7/20/3**	**19/7/4**		**11/13/6**	**23/3/4**	