Corrigendum

Corrigendum to “Derivation of Diagonally Implicit Block Backward Differentiation Formulas for Solving Stiff Initial Value Problems”

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In the article titled “Derivation of Diagonally Implicit Block Backward Differentiation Formulas for Solving Stiff Initial Value Problems,” [1] there are misreported information and typing errors that are corrected as follows.

In the fourth paragraph of the “Introduction” section, the sentence “The following equations represent the formulas of fully implicit 2-point block backward differentiation formulas of order three (FI2BBDF(3)) and fully implicit 3-point block backward differentiation formula of order three (FI3BBDF(3))” should be corrected to “The following equations represent the formulas of fully implicit 2-point block backward differentiation formulas of order three (FI2BBDF(3)) and fully implicit 3-point block backward differentiation formula of order five (FI3BBDF(5)).” Accordingly, equation (4) should be written as follows:

FI3BBDF(5). One has

$$\begin{aligned} y_{n+1} &= \frac{1}{10}y_{n-2} - \frac{3}{4}y_{n-1} + 3y_n - \frac{3}{2}y_{n+2} + \frac{3}{20}y_{n+3} \\ &\quad + 3hf_{n+1}, \\ y_{n+2} &= -\frac{3}{65}y_{n-2} + \frac{4}{13}y_{n-1} - \frac{12}{13}y_n + \frac{24}{13}y_{n+1} - \frac{12}{65}y_{n+3} \\ &\quad + \frac{12}{13}hf_{n+2}, \end{aligned}$$

$$\begin{aligned} y_{n+3} &= \frac{12}{137}y_{n-2} - \frac{75}{137}y_{n-1} + \frac{200}{137}y_n - \frac{300}{137}y_{n+1} \\ &\quad + \frac{300}{137}y_{n+2} + \frac{60}{137}hf_{n+3}. \end{aligned} \quad (4)$$

In the fifth paragraph of the “Introduction” section, the sentence “The formulas of fully implicit 2-point block extended backward differentiation formula of order three (FI2BEBDF(3)) and fully implicit 3-point block extended backward differentiation formula of order three (FI3BEBDF(3)) are given in the following forms” should be corrected to “The formulas of fully implicit 2-point block extended backward differentiation formula of order four (FI2BEBDF(4)) and fully implicit 3-point block extended backward differentiation formula of order six (FI3BEBDF(6)) are given in the following forms.” Accordingly, equation (5) shows the “FI2BEBDF(4)” not “FI2BEBDF(3).” Moreover, equation (6) should be written as follows:

FI3BEBDF(6). One has

$$\begin{aligned} y_{n+1} &= -\frac{1}{80}y_{n-2} + \frac{1}{8}y_{n-1} - \frac{3}{4}y_n + \frac{25}{16}y_{n+2} + \frac{3}{40}y_{n+3} \\ &\quad - \frac{3}{2}hf_{n+1} - \frac{3}{4}hf_{n+2}, \end{aligned}$$

$$\begin{aligned}
y_{n+2} &= -\frac{3}{25}y_{n-2} + y_{n-1} - 4y_n + 12y_{n+1} - \frac{197}{25}y_{n+3} \\
&\quad + 12hf_{n+2} + \frac{12}{5}hf_{n+3}, \\
y_{n+3} &= \frac{394}{14919}y_{n-2} - \frac{2925}{14919}y_{n-1} + \frac{9600}{14919}y_n \\
&\quad - \frac{18700}{14919}y_{n+1} + \frac{26550}{14919}y_{n+2} + \frac{8820}{14919}hf_{n+3} \\
&\quad - \frac{600}{14919}hf_{n+4}.
\end{aligned} \tag{6}$$

In “Numerical Results” section, the sentence “Tables 1 and 2 present the performance comparison of DI2BBDF(2), DI2BBDF(3), and DI2BBDF(4) with FI2BBDF(3) and FI2BEBDF(3), whereas Tables 3–6 exhibit the comparison of proposed methods with FI3BBDF(3) and FI3BEBDF(3)” should be changed to “Tables 1 and 2 present the performance comparison of DI2BBDF(2), DI2BBDF(3), and DI2BBDF(4) with FI2BBDF(3) and FI2BEBDF(4), whereas Tables 3–6 exhibit the comparison of proposed methods with FI3BBDF(5) and FI3BEBDF(5).” Moreover, the notations used in Tables 1–6 are updated as follows:

h : step size

MAXE: maximum error

TIME: time execution using high performance computer (HPC)

DI2BBDF(2): diagonally implicit 2-point block backward differentiation formulas of order 2

DI2BBDF(3): diagonally implicit 2-point block backward differentiation formulas of order 3

DI2BBDF(4): diagonally implicit 2-point block backward differentiation formulas of order 4

FI2BBDF(3): fully implicit 2-point block backward differentiation formulas of order 3

FI2BEBDF(4): fully implicit 2-point block extended backward differentiation formulas of order 4

FI3BBDF(5): fully implicit 3-point block backward differentiation formulas of order 5

FI3BEBDF(6): fully implicit 3-point block extended backward differentiation formulas of order 6.

Therefore, you can find the corrected versions of Tables 1, 2, 3, 4, 5, and 6. Moreover the keys of Figures 5, 6, 7, 8, 9, and 10 should be modified as shown in Tables 1, 2, 3, 4, 5, and 6 and Figures 5, 6, 7, 8, 9, and 10.

In the “Discussion” section, there are corrections in the subsections “Maximum Error” and “Computational Time” explained below.

In subsection “Maximum Error,” the sentence “Among the methods of order three, DI2BBDF(3) is more accurate compared with FI2BBDF(3), FI3BBDF(3), FI2BEBDF(3), and

TABLE 1: The accuracy for Problem 1.

h	Methods	MAXE	TIME
10^{-2}	FI2BBDF(3)	5.67155E-2	1.36773E-3
	FI2BEBDF(4)	5.97499E-2	1.45525E-3
	DI2BBDF(2)	1.10568E-2	4.72498E-3
	DI2BBDF(3)	1.66455E-2	4.77409E-3
	DI2BBDF(4)	2.16342E-2	4.83298E-3
10^{-4}	FI2BBDF(3)	7.34012E-4	1.25797E-1
	FI2BEBDF(4)	3.23640E-5	1.36259E-1
	DI2BBDF(2)	1.18355E-6	1.67260E-1
	DI2BBDF(3)	1.73430E-6	1.69325E-1
	DI2BBDF(4)	2.25966E-6	1.72995E-1
10^{-6}	FI2BBDF(3)	7.35741E-6	1.25700E1
	FI2BEBDF(4)	3.50090E-7	1.36230E1
	DI2BBDF(2)	1.18742E-10	1.49159E1
	DI2BBDF(3)	1.73634E-10	1.54493E1
	DI2BBDF(4)	2.26000E-10	1.54620E1

TABLE 2: The accuracy for Problem 2.

h	Methods	MAXE	TIME
10^{-2}	FI2BBDF(3)	2.71597E-2	5.96467E-3
	FI2BEBDF(4)	1.49811E-2	6.61025E-3
	DI2BBDF(2)	4.56073E-3	1.04480E-2
	DI2BBDF(3)	6.86126E-3	1.08421E-2
	DI2BBDF(4)	8.93279E-3	1.11089E-2
10^{-4}	FI2BBDF(3)	3.40437E-4	5.90430E-1
	FI2BEBDF(4)	2.62649E-5	6.54305E-1
	DI2BBDF(2)	4.85404E-7	3.73210E-1
	DI2BBDF(3)	7.11155E-7	3.86556E-1
	DI2BBDF(4)	9.26476E-7	3.87070E-1
10^{-6}	FI2BBDF(3)	3.41146E-6	5.90198E1
	FI2BEBDF(4)	2.44097E-7	6.54106E1
	DI2BBDF(2)	4.86843E-11	3.48451E1
	DI2BBDF(3)	7.11903E-11	3.60490E1
	DI2BBDF(4)	9.26598E-11	3.60649E1

TABLE 3: The accuracy for Problem 3.

h	Methods	MAXE	TIME
10^{-2}	FI3BBDF(5)	3.56692E-2	1.41642E-3
	FI3BEBDF(6)	1.24084E-2	3.02167E-3
	DI2BBDF(2)	1.17256E-3	4.48489E-3
	DI2BBDF(3)	1.72278E-3	4.81200E-3
	DI2BBDF(4)	2.25003E-3	4.85301E-3
10^{-4}	FI3BBDF(5)	4.35640E-4	1.30103E-1
	FI3BEBDF(6)	7.06516E-5	2.08115E-1
	DI2BBDF(2)	1.18749E-7	1.60304E-1
	DI2BBDF(3)	1.73636E-7	1.77445E-1
	DI2BBDF(4)	2.26000E-7	1.78064E-1
10^{-6}	FI3BBDF(5)	4.34625E-6	1.29775E1
	FI3BEBDF(6)	7.03257E-7	2.07609E0
	DI2BBDF(2)	1.24989E-11	1.50739E1
	DI2BBDF(3)	1.73636E-11	1.55073E1
	DI2BBDF(4)	2.25999E-11	1.60216E1

TABLE 4: The accuracy for Problem 4.

h	Methods	MAXE	TIME
10^{-2}	FI3BBDF(5)	6.62694E99	7.01775E-3
	FI3BEBDF(6)	1.68449E-1	1.37847E-2
	DI2BBDF(2)	2.80830E-1	1.06871E-2
	DI2BBDF(3)	4.00389E-1	1.24969E-2
	DI2BBDF(4)	4.77342E-1	1.26502E-2
10^{-4}	FI3BBDF(5)	8.45376E-3	6.76737E-1
	FI3BEBDF(6)	6.95725E-3	1.35671E+0
	DI2BBDF(2)	3.56255E-5	4.32359E-1
	DI2BBDF(3)	5.24241E-5	4.42599E-1
	DI2BBDF(4)	6.85105E-5	4.56207E-1
10^{-6}	FI3BBDF(5)	8.54545E-5	6.76819E1
	FI3BEBDF(6)	7.18859E-5	1.35862E2
	DI2BBDF(2)	3.60130E-9	4.00010E1
	DI2BBDF(3)	5.26673E-9	4.00192E1
	DI2BBDF(4)	6.85529E-9	4.10322E1

TABLE 5: The accuracy for Problem 5.

h	Methods	MAXE	TIME
10^{-2}	FI3BBDF(5)	5.25481E-3	5.78083E-4
	FI3BEBDF(6)	3.88475E-3	9.16583E-4
	DI2BBDF(2)	8.56253E-5	2.29836E-4
	DI2BBDF(3)	1.21629E-4	1.89066E-4
	DI2BBDF(4)	1.65094E-4	2.30074E-4
10^{-4}	FI3BBDF(5)	5.51558E-5	4.83860E-2
	FI3BEBDF(6)	4.27506E-5	7.74877E-2
	DI2BBDF(2)	8.89803E-9	1.17438E-2
	DI2BBDF(3)	1.30124E-8	1.31578E-2
	DI2BBDF(4)	1.69456E-8	1.26071E-2
10^{-6}	FI3BBDF(5)	5.51803E-7	5.47768E+0
	FI3BEBDF(6)	4.27924E-7	7.77643E+0
	DI2BBDF(2)	1.26115E-11	1.19318E+0
	DI2BBDF(3)	6.27106E-11	1.33892E+0
	DI2BBDF(4)	1.04222E-11	1.26146E+0

TABLE 6: The accuracy for Problem 6.

h	Methods	MAXE	TIME
10^{-2}	FI3BBDF(5)	2.18555E-3	2.83084E-4
	FI3BEBDF(6)	1.52719E-3	4.28500E-4
	DI2BBDF(2)	3.87041E-5	5.38826E-5
	DI2BBDF(3)	5.47958E-5	5.31673E-5
	DI2BBDF(4)	7.47696E-5	6.18877E-5
10^{-4}	FI3BBDF(5)	2.29812E-5	1.48627E-2
	FI3BEBDF(6)	1.78708E-5	2.32184E-2
	DI2BBDF(2)	4.01638E-9	3.49712E-3
	DI2BBDF(3)	5.87347E-9	3.75295E-3
	DI2BBDF(4)	7.64927E-9	3.64804E-3
10^{-6}	FI3BBDF(5)	2.29936E-7	1.46660E+0
	FI3BEBDF(6)	1.78973E-7	2.28775E+0
	DI2BBDF(2)	9.90807E-12	3.38157E-1
	DI2BBDF(3)	3.77716E-11	3.69837E-1
	DI2BBDF(4)	4.62796E-12	3.56802E-1

FIGURE 5: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 1. FIGURE 6: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 2.

FI3BEBDF(3)” should be changed to “Among the methods of order three, DI2BBDF(3) is more accurate compared with FI2BBDF(3), FI3BBDF(5), FI2BEBDF(4), and FI3BEBDF(6).”

In subsection “Computational Time,” the sentence “In Tables 1-2, it can be seen that the execution time taken by DI2BBDF(2), DI2BBDF(3), and DI2BBDF(4) is comparable with that of FI2BBDF(3) and FI2BEBDF(3)” should be changed to “In Tables 1-2, it can be seen that the execution time taken by DI2BBDF(2), DI2BBDF(3), and DI2BBDF(4) is comparable with that of FI2BBDF(3) and FI2BEBDF(4).” In addition, the sentence “However, Tables 3–6 show that the proposed methods compute faster than FI3BBDF(3) and FI3BEBDF(3)” should be changed to “However, Tables 3–6 show that the proposed methods compute faster than FI3BBDF(3) and FI3BEBDF(6).”

The authors apologize to the readers for these errors.

FIGURE 7: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 3. FIGURE 10: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 6. FIGURE 8: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 4. FIGURE 9: Graph of $\log(\text{MAXE})$ versus $\log(h)$ for Problem 5.

References

- [1] I. S. Zawawi, Z. B. Ibrahim, and K. I. Othman, "Derivation of diagonally implicit block backward differentiation formulas for solving stiff initial value problems," *Mathematical Problems in Engineering*, vol. 2015, Article ID 179231, 13 pages, 2015.