

Supporting Document of “Dual Mutations
Collaboration Mechanism with Elites Guiding and
Inferiors Eliminating Techniques for Differential
Evolution”

TABLE A3: Mean and standard deviation of function error values obtained by DMIE-DE and its three versions on 30D test functions in CEC2017 over 50 independent runs.

Func.	DMIE-DE1		DMIE-DE2		DMIE-DE3		DMIE-DE	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
f_1	1.34E-14	4.46E-15	1.68E-14	5.52E-15	8.81E-15	6.97E-15	8.81E-15	6.97E-15
f_3	1.10E-13	4.21E-14	2.13E-13	8.02E-14	7.05E-14	2.71E-14	7.62E-14	2.95E-14
f_4	4.04E+01	2.86E+01	4.80E+01	2.44E+01	5.28E+01	1.91E+01	5.46E+01	1.58E+01
f_5	3.13E+01	1.00E+01	4.28E+01	1.09E+01	3.05E+01	9.63E+00	3.01E+01	1.03E+01
f_6	4.44E-03	1.23E-02	2.59E-02	3.60E-02	4.75E-04	1.29E-03	1.41E-06	7.12E-06
f_7	5.90E+01	1.03E+01	7.72E+01	1.31E+01	5.95E+01	1.04E+01	5.77E+01	1.06E+01
f_8	3.21E+01	8.36E+00	4.36E+01	1.24E+01	3.18E+01	9.15E+00	3.06E+01	8.74E+00
f_9	7.63E-01	9.34E-01	8.25E+00	8.44E+00	3.86E-01	5.52E-01	7.08E-02	1.70E-01
f_{10}	2.23E+03	5.16E+02	2.85E+03	4.96E+02	2.64E+03	7.35E+02	3.12E+03	6.85E+02
f_{11}	4.53E+01	2.85E+01	6.00E+01	3.59E+01	3.60E+01	2.74E+01	3.50E+01	2.74E+01
f_{12}	1.10E+03	4.21E+02	3.74E+03	3.69E+03	1.26E+03	3.12E+02	9.72E+02	4.26E+02
f_{13}	3.09E+01	1.65E+01	7.02E+01	9.70E+01	3.37E+01	8.04E+00	2.66E+01	9.49E+00
f_{14}	2.69E+01	3.06E+00	4.22E+01	1.02E+01	3.24E+01	4.16E+00	2.87E+01	5.53E+00
f_{15}	1.92E+01	1.20E+01	3.81E+01	3.33E+01	1.93E+01	1.08E+01	1.32E+01	6.31E+00
f_{16}	2.13E+02	1.40E+02	4.72E+02	2.68E+02	3.02E+02	1.98E+02	3.39E+02	1.99E+02
f_{17}	7.42E+01	3.58E+01	8.04E+01	6.55E+01	9.30E+01	6.49E+01	6.72E+01	3.88E+01
f_{18}	4.30E+01	2.48E+01	6.25E+01	4.39E+01	3.22E+01	1.44E+01	3.09E+01	1.24E+01
f_{19}	1.16E+01	3.83E+00	3.26E+01	3.20E+01	1.05E+01	3.02E+00	8.66E+00	2.93E+00
f_{20}	4.50E+01	3.32E+01	8.84E+01	9.88E+01	6.79E+01	6.46E+01	7.81E+01	6.46E+01
f_{21}	2.15E+02	4.46E+00	2.46E+02	1.12E+01	2.35E+02	9.41E+00	2.32E+02	7.62E+00
f_{22}	1.00E+02	7.44E-01	3.19E+02	7.68E+02	1.00E+02	5.88E-01	1.00E+02	0.00E+00
f_{23}	3.81E+02	1.04E+01	3.93E+02	1.17E+01	3.81E+02	9.72E+00	3.79E+02	1.10E+01
f_{24}	4.50E+02	9.96E+00	4.65E+02	1.31E+01	4.53E+02	9.81E+00	4.44E+02	1.05E+01
f_{25}	3.88E+02	7.69E+00	3.87E+02	8.55E-01	3.87E+02	4.77E-01	3.87E+02	4.26E-02
f_{26}	1.06E+03	1.92E+02	1.48E+03	1.69E+02	1.30E+03	1.95E+02	1.20E+03	1.01E+02
f_{27}	5.06E+02	8.23E+00	5.11E+02	8.16E+00	5.08E+02	6.87E+00	5.02E+02	9.19E+00
f_{28}	3.86E+02	5.29E+01	3.54E+02	6.31E+01	3.54E+02	6.06E+01	3.60E+02	5.93E+01
f_{29}	4.48E+02	2.50E+01	5.57E+02	1.12E+02	4.71E+02	4.13E+01	4.48E+02	3.35E+01
f_{30}	2.15E+03	1.75E+02	2.14E+03	1.65E+02	2.06E+03	1.44E+02	2.04E+03	8.34E+01

TABLE A4: Mean and standard deviation of function error values obtained by DMIE-DE and its three versions on 100D test functions in CEC2017 over 50 independent runs.

Func.	DMIE-DE1		DMIE-DE2		DMIE-DE3		DMIE-DE	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
f_1	1.36E-13	2.89E-13	3.62E-10	1.14E-09	5.42E-09	6.94E-09	1.99E-10	2.78E-10
f_3	2.05E-04	2.31E-04	1.09E-01	3.97E-01	5.16E-01	5.52E-01	2.23E-01	2.13E-01
f_4	1.11E+02	7.01E+01	1.90E+02	5.77E+01	1.55E+02	5.37E+01	1.59E+02	4.94E+01
f_5	1.67E+02	5.91E+01	1.54E+02	2.55E+01	1.11E+02	2.18E+01	9.35E+01	1.76E+01
f_6	5.95E-01	3.84E-01	3.91E-01	2.77E-01	5.07E-02	4.21E-02	2.25E-03	3.77E-03
f_7	3.81E+02	2.13E+01	3.14E+02	3.30E+01	2.15E+02	1.67E+01	2.00E+02	1.68E+01
f_8	1.87E+02	4.55E+01	1.51E+02	2.17E+01	1.13E+02	1.97E+01	1.02E+02	1.69E+01
f_9	2.63E+01	8.88E+00	1.72E+02	1.03E+02	1.75E+01	9.30E+00	6.24E+00	4.77E+00
f_{10}	1.91E+04	6.12E+02	1.27E+04	3.00E+03	1.13E+04	1.33E+03	1.61E+04	5.79E+03
f_{11}	8.86E+02	2.00E+02	5.02E+02	1.50E+02	5.71E+02	1.23E+02	5.42E+02	1.56E+02
f_{12}	3.09E+04	1.20E+04	5.80E+04	2.43E+04	7.97E+04	5.12E+04	5.74E+04	3.50E+04
f_{13}	1.36E+03	1.20E+03	4.52E+02	4.17E+02	1.10E+03	1.01E+03	9.53E+02	8.85E+02
f_{14}	4.14E+02	8.38E+01	4.13E+02	1.09E+02	3.22E+02	6.29E+01	3.28E+02	6.62E+01
f_{15}	3.17E+02	7.83E+01	4.50E+02	4.60E+02	3.23E+02	8.03E+01	3.17E+02	7.24E+01
f_{16}	2.37E+03	4.54E+02	2.36E+03	5.68E+02	2.10E+03	5.01E+02	1.97E+03	4.37E+02
f_{17}	1.84E+03	2.54E+02	1.64E+03	3.57E+02	1.28E+03	4.27E+02	1.35E+03	5.16E+02
f_{18}	3.16E+02	7.88E+01	1.06E+03	9.03E+02	2.59E+02	7.35E+01	2.50E+02	7.36E+01
f_{19}	2.33E+02	6.14E+01	2.19E+02	5.40E+01	2.26E+02	5.37E+01	2.19E+02	4.35E+01
f_{20}	2.24E+03	2.82E+02	1.76E+03	3.91E+02	1.42E+03	3.50E+02	1.95E+03	8.36E+02
f_{21}	3.63E+02	6.15E+01	3.84E+02	3.14E+01	3.38E+02	1.80E+01	3.28E+02	1.96E+01
f_{22}	1.99E+04	6.08E+02	1.32E+04	2.39E+03	1.22E+04	2.36E+03	1.85E+04	5.66E+03
f_{23}	6.24E+02	1.78E+01	7.04E+02	2.37E+01	6.59E+02	1.98E+01	6.28E+02	2.66E+01
f_{24}	9.77E+02	1.95E+01	1.06E+03	3.12E+01	9.96E+02	2.39E+01	9.83E+02	2.52E+01
f_{25}	7.32E+02	5.73E+01	7.25E+02	5.18E+01	7.31E+02	5.11E+01	7.35E+02	4.36E+01
f_{26}	4.13E+03	2.26E+02	4.99E+03	2.86E+02	4.25E+03	2.67E+02	3.98E+03	2.22E+02
f_{27}	6.80E+02	3.03E+01	6.73E+02	3.09E+01	6.48E+02	2.85E+01	6.45E+02	2.96E+01
f_{28}	5.25E+02	3.11E+01	5.29E+02	3.21E+01	5.42E+02	3.22E+01	5.32E+02	3.11E+01
f_{29}	2.07E+03	3.34E+02	2.41E+03	4.06E+02	1.83E+03	3.32E+02	1.71E+03	3.54E+02
f_{30}	2.67E+03	2.44E+02	2.64E+03	2.29E+02	2.56E+03	2.14E+02	2.46E+03	1.61E+02

TABLE A5: Mean and standard deviation of function error values obtained by DMIE-DE with different gip values on 30D test functions in CEC2017 over 50 independent runs.

Func.	$gip = 200$		$gip = 300$		$gip = 400$		$gip = 500$		$gip = 600$	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
f_1	1.08E-14	6.13E-15	8.53E-15	7.03E-15	8.81E-15	6.97E-15	8.53E-15	7.03E-15	8.24E-15	7.09E-15
f_3	8.30E+02	5.87E+03	7.50E-14	2.91E-14	7.62E-14	2.95E-14	8.30E-14	3.29E-14	5.68E-14	1.15E-14
f_4	5.69E+01	2.08E+01	5.69E+01	1.19E+01	5.46E+01	1.58E+01	5.42E+01	1.76E+01	5.99E+01	1.83E+01
f_5	3.00E+01	1.01E+01	3.98E+01	9.90E+00	3.01E+01	1.03E+01	3.28E+01	1.25E+01	3.19E+01	1.14E+01
f_6	7.43E-01	2.94E-06	4.96E-06	1.59E-06	1.41E-06	7.12E-06	1.02E-06	2.53E-06	3.66E-06	1.25E-06
f_7	5.99E+01	1.06E+01	6.13E+01	1.33E+01	5.77E+01	1.06E+01	6.17E+01	1.40E+01	6.17E+01	1.23E+01
f_8	3.20E+01	8.86E+00	3.13E+01	1.18E+01	3.06E+01	8.74E+00	3.03E+01	1.03E+01	3.90E+01	1.02E+01
f_9	9.79E-01	2.49E-01	5.25E-02	1.31E-01	7.08E-02	1.70E-01	1.21E-01	4.12E-01	1.34E-01	3.96E-01
f_{10}	3.93E+03	6.09E+02	3.98E+03	6.89E+02	3.12E+03	6.85E+02	2.90E+03	7.64E+02	3.14E+03	7.50E+02
f_{11}	3.46E+01	2.41E+01	3.50E+01	1.58E+01	3.50E+01	2.74E+01	3.58E+01	2.82E+01	3.60E+01	2.34E+01
f_{12}	8.62E+02	3.43E+02	1.01E+03	3.51E+02	9.72E+02	4.26E+02	8.37E+02	3.35E+02	9.22E+02	3.06E+02
f_{13}	2.85E+01	8.90E+00	2.89E+01	1.05E+01	2.66E+01	9.49E+00	2.78E+01	1.23E+01	2.57E+01	7.84E+00
f_{14}	2.99E+01	7.97E+00	2.99E+01	4.05E+00	2.87E+01	5.53E+00	2.86E+01	6.47E+00	2.78E+01	7.05E+00
f_{15}	1.35E+01	7.29E+00	1.36E+01	7.60E+00	1.32E+01	6.31E+00	1.54E+01	9.00E+00	1.49E+01	9.24E+00
f_{16}	3.69E+02	1.93E+02	2.55E+02	1.77E+02	3.39E+02	1.99E+02	2.95E+02	1.85E+02	5.71E+02	2.12E+02
f_{17}	6.58E+01	4.03E+01	7.20E+01	3.69E+01	6.72E+01	3.88E+01	6.72E+01	3.27E+01	7.04E+01	4.66E+01
f_{18}	3.30E+01	1.25E+01	3.10E+01	9.61E+00	3.09E+01	1.24E+01	3.13E+01	1.79E+01	3.13E+01	1.17E+01
f_{19}	8.71E+00	2.90E+00	8.84E+00	2.56E+00	8.66E+00	2.93E+00	8.12E+00	3.01E+00	8.77E+00	3.09E+00
f_{20}	7.99E+01	6.19E+01	7.54E+01	5.02E+01	7.81E+01	6.46E+01	6.86E+01	5.00E+01	8.85E+01	5.21E+01
f_{21}	2.34E+02	1.10E+01	2.39E+02	8.67E+00	2.32E+02	7.62E+00	2.30E+02	9.66E+00	2.38E+02	1.02E+01
f_{22}	1.00E+02	0.00E+00	1.07E+02	5.16E+01	1.00E+02	0.00E+00	1.00E+02	0.00E+00	1.41E+02	2.88E+02
f_{23}	3.79E+02	1.03E+01	3.80E+02	1.14E+01	3.79E+02	1.10E+01	3.81E+02	1.41E+01	3.82E+02	1.14E+01
f_{24}	4.50E+02	9.57E+00	4.52E+02	1.22E+01	4.44E+02	1.05E+01	4.53E+02	1.14E+01	4.51E+02	1.08E+01
f_{25}	3.87E+02	6.72E-01	3.87E+02	5.35E-02	3.87E+02	4.26E-02	3.87E+02	7.33E-02	3.87E+02	7.44E-02
f_{26}	1.24E+03	1.12E+02	1.20E+03	1.02E+02	1.20E+03	1.01E+02	1.27E+03	1.26E+02	1.20E+03	1.13E+02
f_{27}	5.02E+02	7.31E+00	5.02E+02	6.02E+00	5.02E+02	9.19E+00	5.03E+02	6.99E+00	5.03E+02	7.29E+00
f_{28}	3.66E+02	6.13E+01	3.22E+02	4.44E+01	3.60E+02	5.93E+01	3.27E+02	5.31E+01	3.40E+02	5.72E+01
f_{29}	4.51E+02	4.43E+01	4.55E+02	3.25E+01	4.48E+02	3.35E+01	4.59E+02	5.01E+01	4.60E+02	5.31E+01
f_{30}	2.05E+03	8.15E+01	2.07E+03	1.55E+02	2.04E+03	8.34E+01	2.04E+03	1.01E+02	2.06E+03	9.83E+01

TABLE A6: Mean and standard deviation of function error values obtained by DMIE-DE with different gip values on 100D test functions in CEC2017 over 50 independent runs.

Func.	$gip = 200$		$gip = 300$		$gip = 400$		$gip = 500$		$gip = 600$	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
f_1	1.69E-10	4.34E-11	1.37E-10	2.55E-10	1.99E-10	2.78E-10	3.24E-10	4.06E-10	6.16E-10	7.67E-10
f_3	6.87E-01	8.35E-02	1.25E-01	9.50E-02	2.23E-01	2.13E-01	3.23E-01	3.75E-01	9.09E+01	6.41E+02
f_4	1.49E+02	6.07E+01	1.42E+02	5.46E+01	1.59E+02	4.94E+01	1.71E+02	4.02E+01	1.60E+02	5.09E+01
f_5	1.06E+02	2.18E+01	1.01E+02	1.83E+01	9.35E+01	1.76E+01	1.06E+02	1.66E+01	9.69E+01	1.63E+01
f_6	2.75E-03	5.21E-03	3.05E-03	4.66E-03	2.25E-03	3.77E-03	1.82E-03	3.41E-03	2.34E-03	3.75E-03
f_7	1.99E+02	2.02E+01	2.02E+02	2.07E+01	2.00E+02	1.68E+01	1.96E+02	1.43E+01	1.99E+02	1.59E+01
f_8	1.90E+02	1.96E+01	9.70E+01	1.79E+01	1.02E+02	1.69E+01	1.04E+02	4.58E+01	9.50E+01	1.83E+01
f_9	6.74E+00	7.08E+00	7.97E+00	7.91E+00	6.24E+00	4.77E+00	5.45E+00	3.22E+00	6.86E+00	4.53E+00
f_{10}	1.56E+04	5.20E+03	1.72E+04	5.58E+03	1.61E+04	5.79E+03	1.54E+04	5.78E+03	1.75E+04	5.76E+03
f_{11}	5.79E+02	1.43E+02	5.70E+02	1.40E+02	5.42E+02	1.56E+02	5.88E+02	1.57E+02	5.89E+02	1.34E+02
f_{12}	5.34E+04	2.67E+04	4.60E+04	1.77E+04	5.74E+04	3.50E+04	5.67E+04	2.42E+04	5.86E+04	3.47E+04
f_{13}	9.98E+02	7.71E+02	9.82E+02	9.71E+02	9.53E+02	8.85E+02	8.16E+02	8.16E+02	8.85E+02	8.27E+02
f_{14}	3.13E+02	6.42E+01	3.29E+02	6.17E+01	3.28E+02	6.62E+01	3.32E+02	5.31E+01	3.28E+02	6.79E+01
f_{15}	3.15E+02	7.46E+01	3.28E+02	7.58E+01	3.17E+02	7.24E+01	3.08E+02	6.72E+01	3.15E+02	7.43E+01
f_{16}	2.08E+03	5.96E+02	1.95E+03	4.40E+02	1.97E+03	4.37E+02	2.17E+03	5.21E+02	2.07E+03	4.41E+02
f_{17}	1.40E+03	3.64E+02	1.31E+03	3.83E+02	1.35E+03	5.16E+02	1.31E+03	4.32E+02	1.35E+03	4.27E+02
f_{18}	2.36E+02	6.93E+01	2.46E+02	7.82E+01	2.50E+02	7.36E+01	2.58E+02	7.66E+01	2.47E+02	7.57E+01
f_{19}	2.12E+02	5.19E+01	2.05E+02	3.70E+01	2.19E+02	4.35E+01	2.20E+02	5.21E+01	2.15E+02	5.63E+01
f_{20}	2.00E+03	6.66E+02	1.90E+03	6.63E+02	1.95E+03	8.36E+02	1.82E+03	7.84E+02	2.01E+03	8.13E+02
f_{21}	3.24E+02	1.70E+01	3.24E+02	1.96E+01	3.28E+02	1.96E+01	3.24E+02	1.85E+01	3.22E+02	1.80E+01
f_{22}	2.00E+04	5.55E+03	1.93E+04	5.42E+03	1.85E+04	5.66E+03	1.92E+04	5.62E+03	1.72E+04	5.80E+03
f_{23}	6.28E+02	2.24E+01	6.24E+02	2.09E+01	6.28E+02	2.66E+01	6.30E+02	2.18E+01	6.34E+02	2.10E+01
f_{24}	9.76E+02	1.88E+01	9.78E+02	1.93E+01	9.83E+02	2.52E+01	9.80E+02	1.83E+01	9.76E+02	1.95E+01
f_{25}	7.37E+02	5.02E+01	7.34E+02	4.70E+01	7.35E+02	4.36E+01	7.29E+02	5.14E+01	7.42E+02	4.20E+01
f_{26}	4.03E+03	2.94E+02	4.04E+03	2.12E+02	3.98E+03	2.22E+02	4.08E+03	2.28E+02	4.00E+03	2.47E+02
f_{27}	6.42E+02	2.42E+01	6.43E+02	2.82E+01	6.45E+02	2.96E+01	6.40E+02	2.78E+01	6.47E+02	2.58E+01
f_{28}	5.37E+02	3.68E+01	5.34E+02	2.89E+01	5.32E+02	3.11E+01	5.36E+02	3.37E+01	5.36E+02	3.65E+01
f_{29}	1.69E+03	3.29E+02	1.74E+03	3.84E+02	1.71E+03	3.54E+02	1.74E+03	3.74E+02	1.73E+03	3.11E+02
f_{30}	2.47E+03	1.66E+02	2.52E+03	1.81E+02	2.46E+03	1.61E+02	2.48E+03	2.02E+02	2.51E+03	2.24E+02

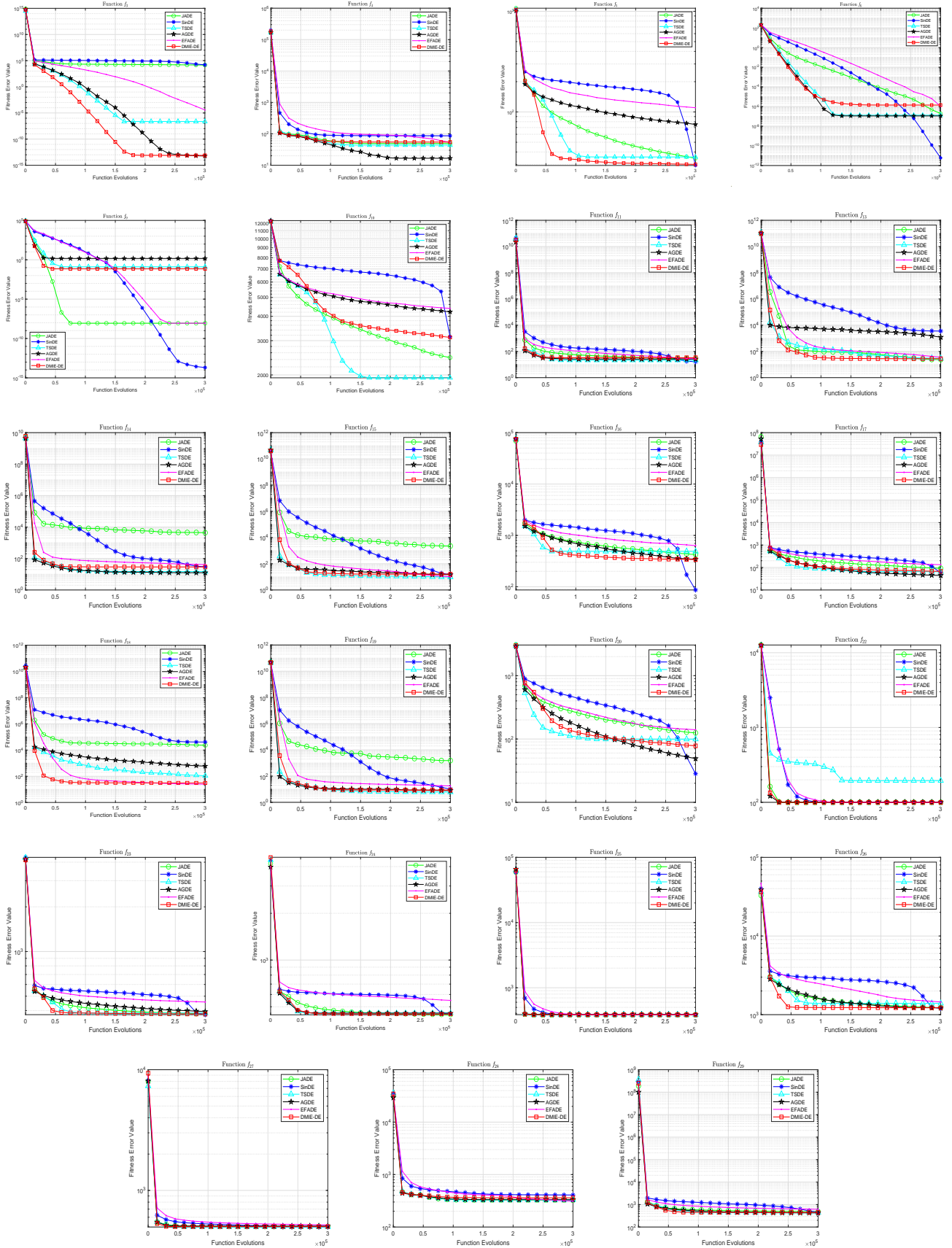


Fig. A1: The convergence process of the mean fitness errors derived from different variants on all 30D benchmark functions except for those presented in the article's main body.

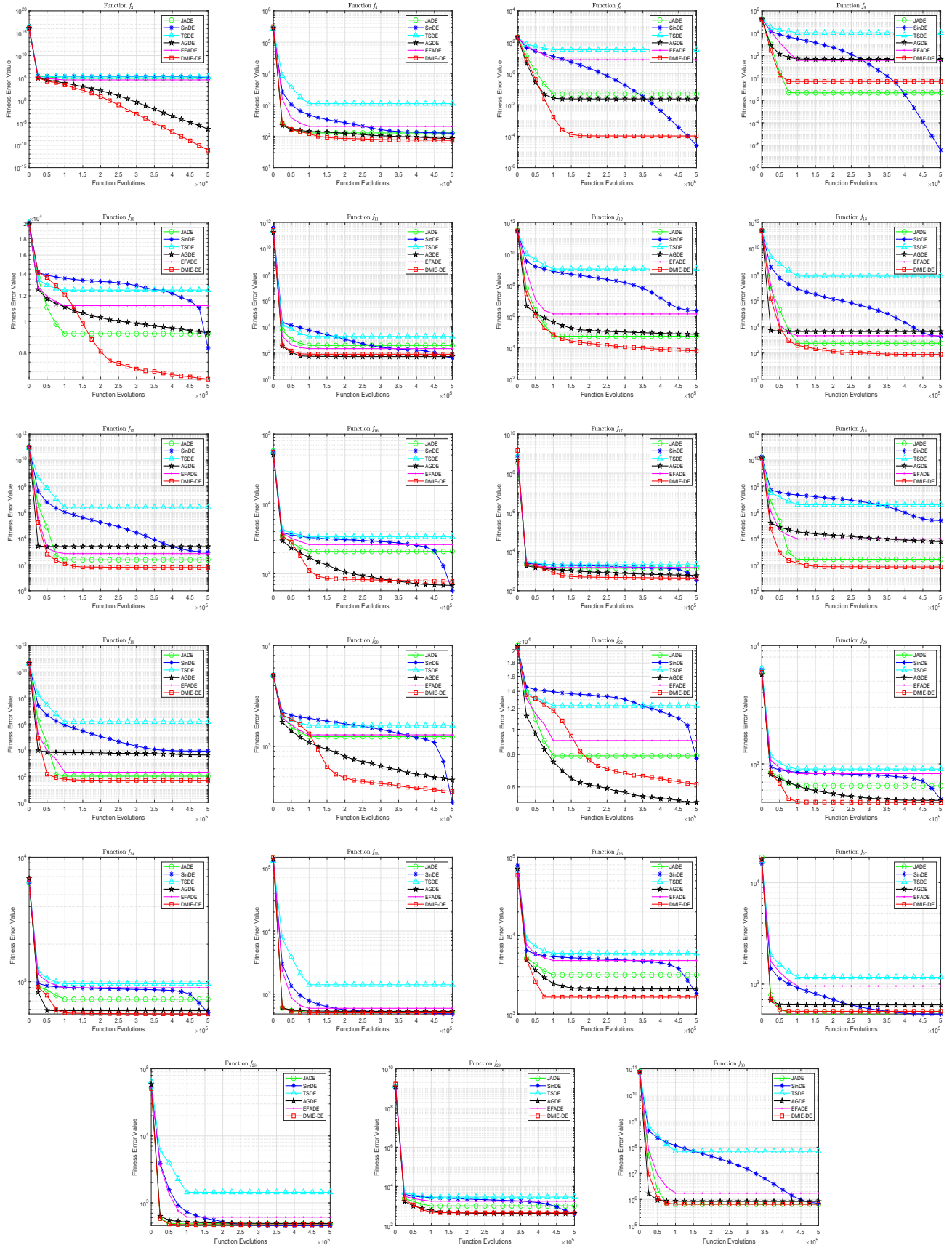


Fig. A2: The convergence process of the mean fitness errors derived from different variants on all 50D benchmark functions except for those presented in the article's main body.

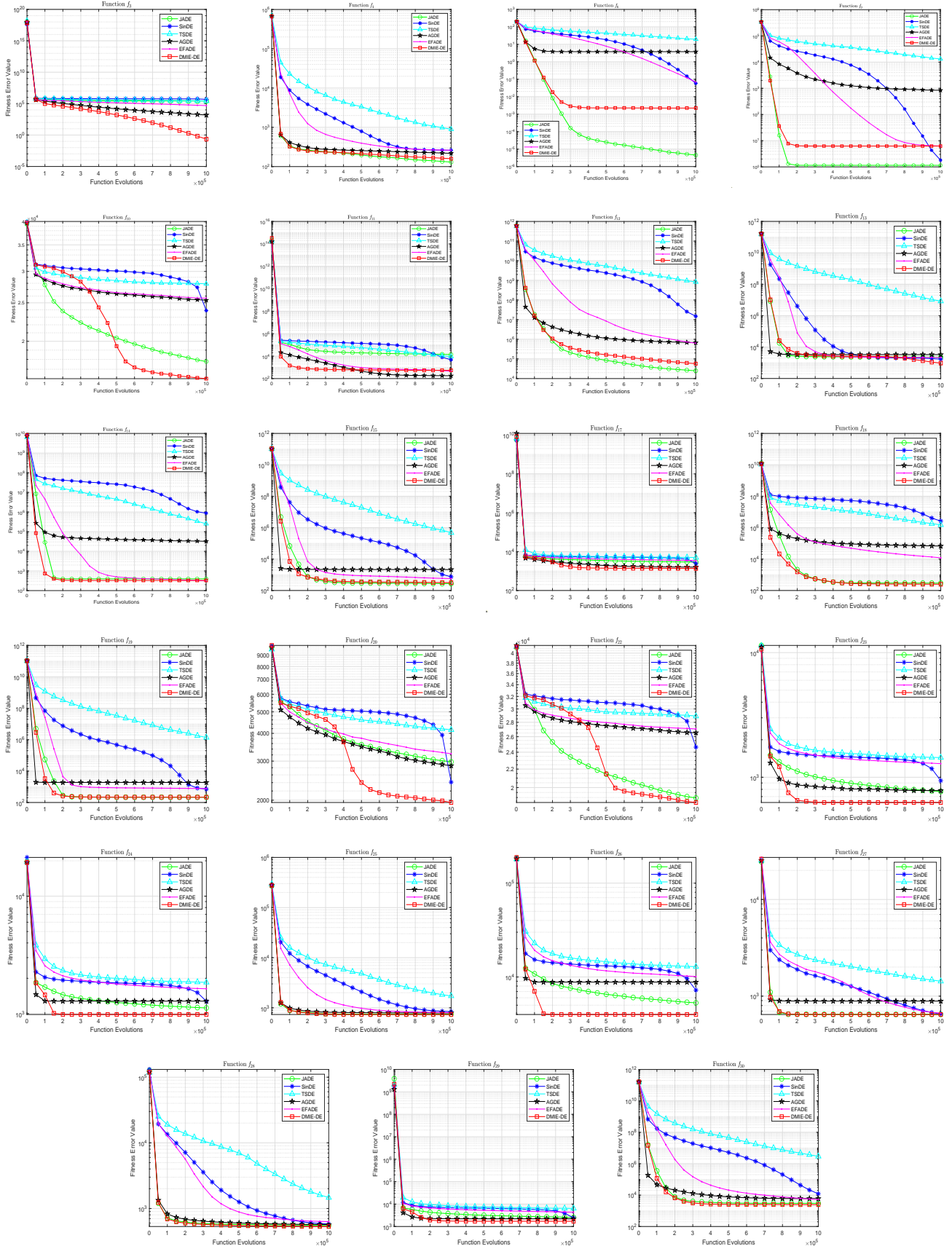


Fig. A3: The convergence process of the mean fitness errors derived from different variants on all 100D benchmark functions except for those presented in the article's main body.

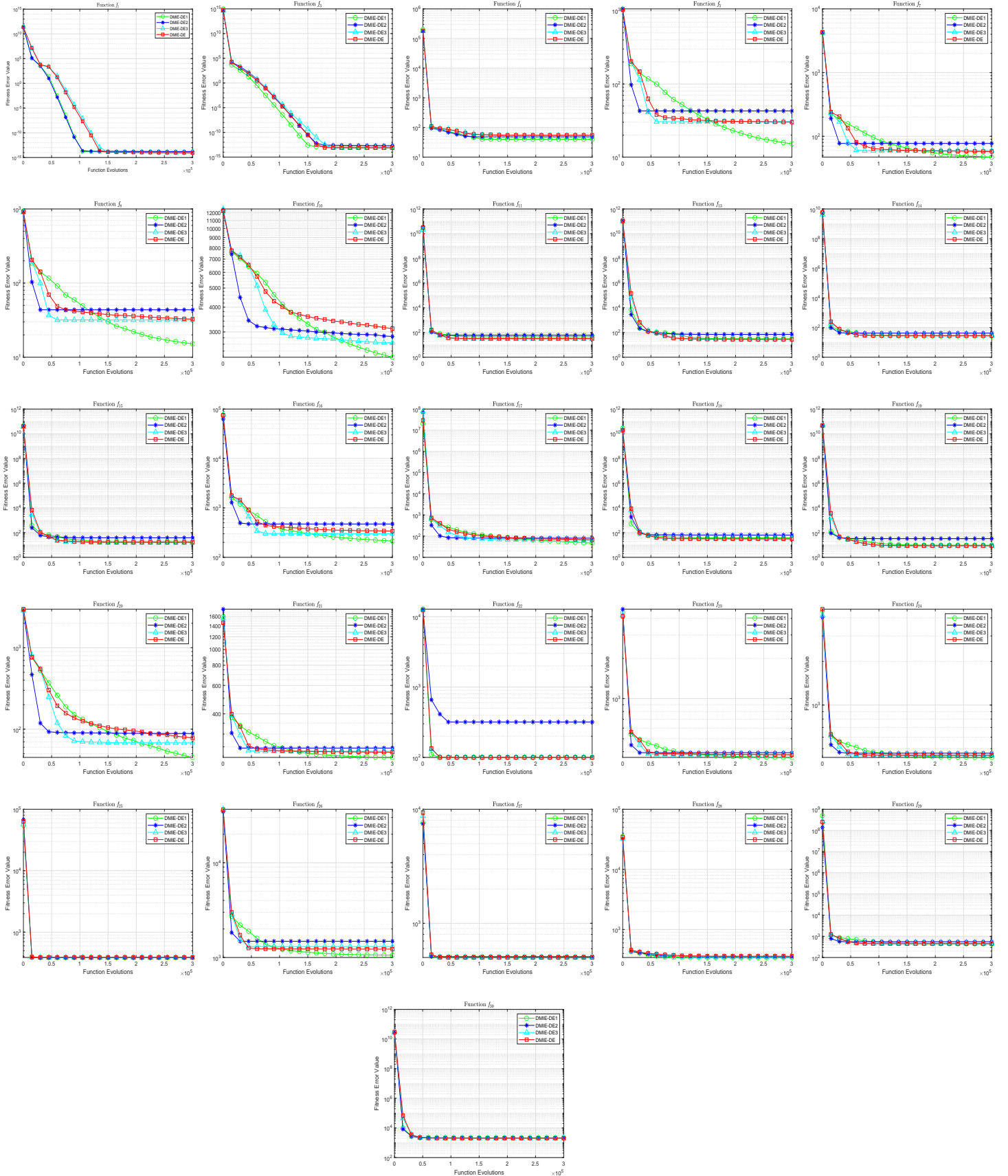


Fig. A4: The convergence process of the mean fitness errors derived from DMIE-DE and its three versions on all 30D benchmark functions except for those presented in the article's main body.

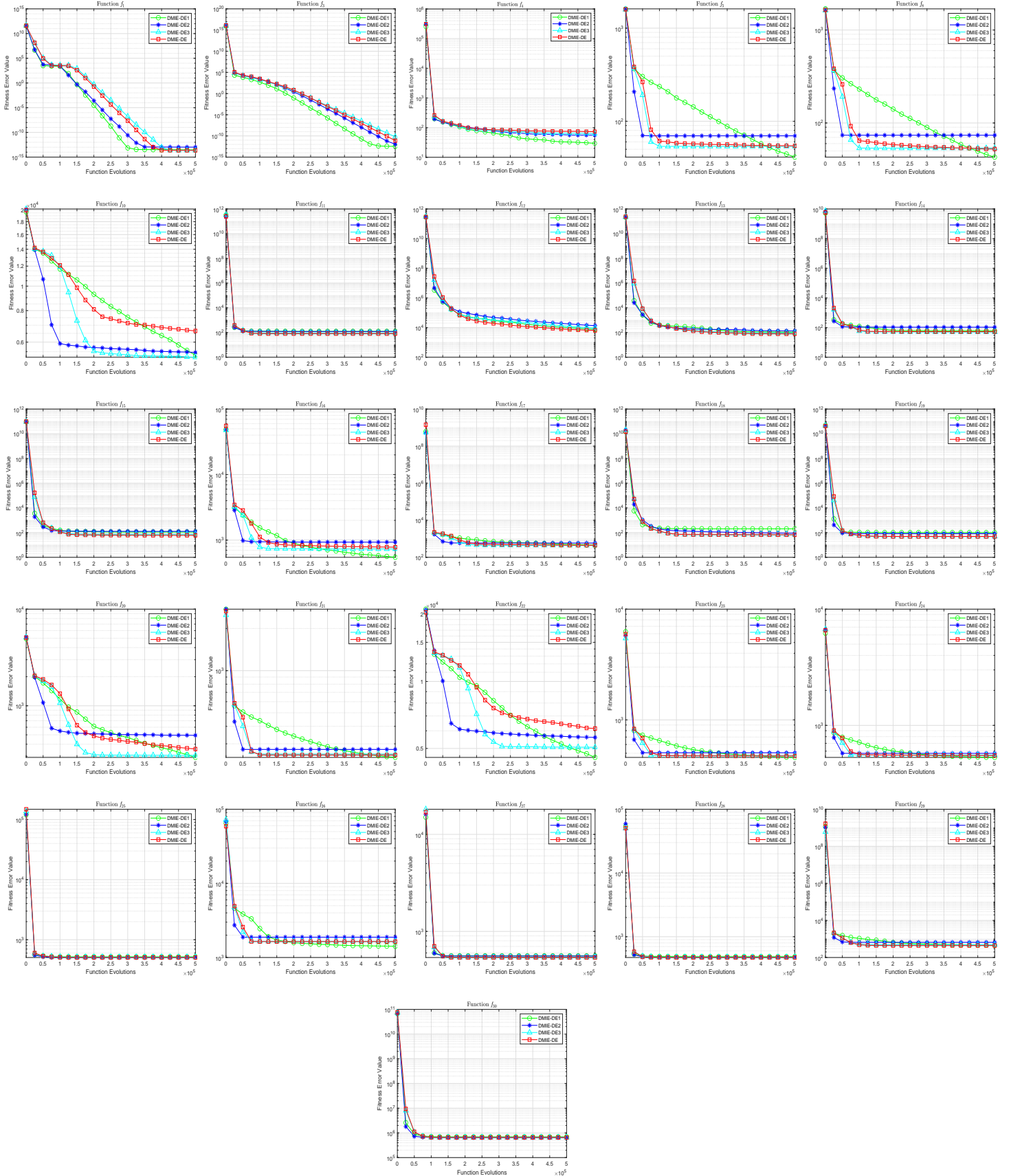


Fig. A5: The convergence process of the mean fitness errors derived from DMIE-DE and its three versions on all 50D benchmark functions except for those presented in the article's main body.

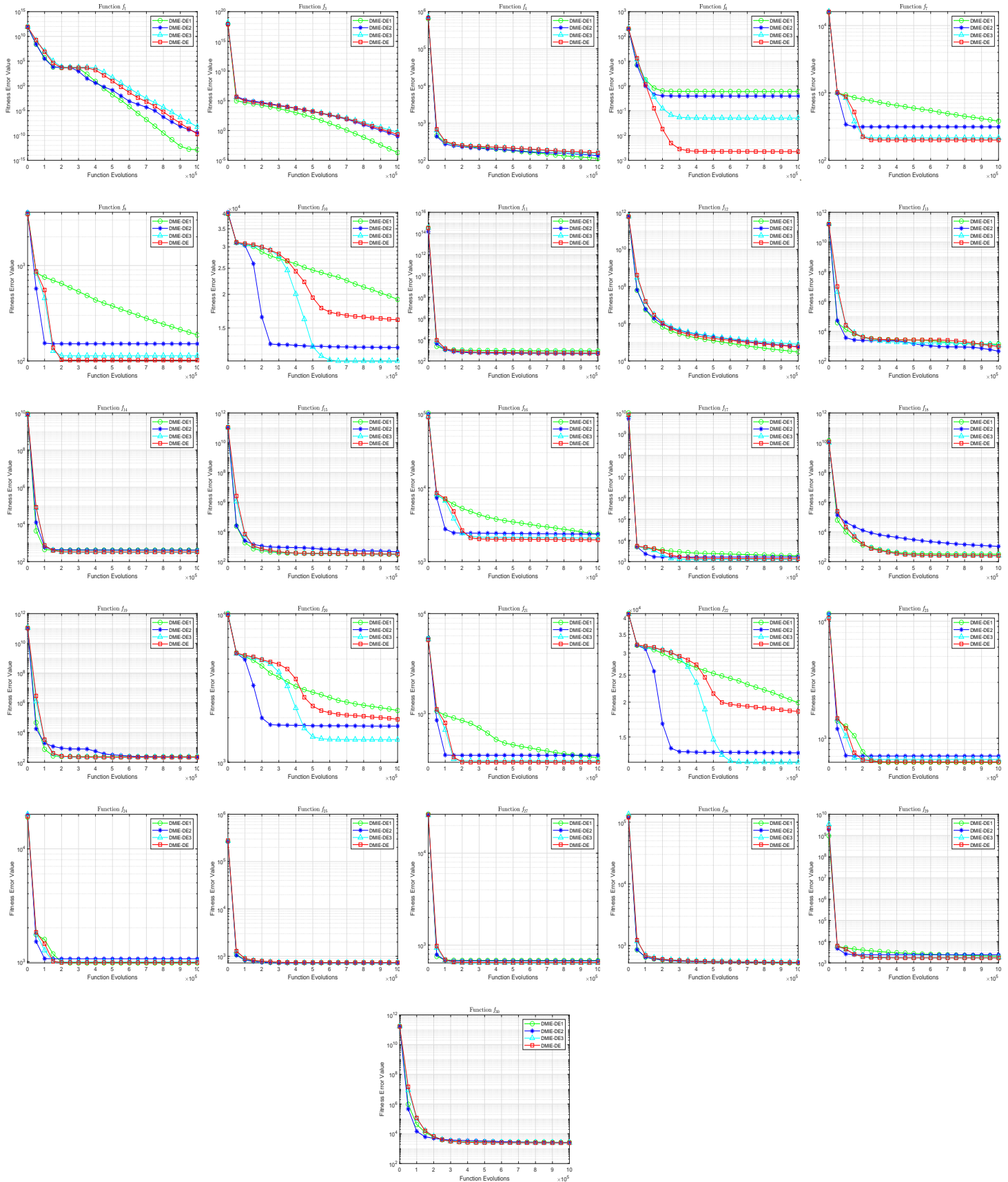


Fig. A6: The convergence process of the mean fitness errors derived from DMIE-DE and its three versions on all 100D benchmark functions except for those presented in the article's main body.