

Leaders and Followers on the CEC2013 Real-Parameter Optimization Benchmark Functions

Yasser Gonzalez-Fernandez and Stephen Chen

Technical Report

School of Information Technology

York University

September 2015

Introduction

The Leaders and Followers (LaF) metaheuristic was implemented following the algorithm description and pseudocode given in [1]. The implementation uses a leaders and followers population size equal to the problem dimension D . LaF was applied to the CEC2013 Real-Parameter Optimization Benchmark Functions [2], and the competition results are reported.

Results

Language: Matlab 2009a

Algorithm: Leaders and Followers (LaF)

System: Windows XP Professional Version 2002, Service Pack 3, Intel Core2 Quad CPU, Q9400@2.66 GHz, 3.25 GB RAM

Table 1: Computational Complexity

	T0	T1	T2	$(T2-T1)/T0$
D = 10	0.1803	2.6718	3.8936	6.7764
D = 30		4.3663	4.7789	2.2884
D = 50		6.1348	7.5709	7.9650

Note: all values are the average of five independent trials.

Table 2: Results for D = 10

Function	Best	Worst	Median	Mean	Std. Dev.
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	1.11E+04	4.51E+05	9.65E+04	1.22E+05	9.51E+04
3	0.00E+00	1.72E+08	2.60E+05	5.96E+06	2.41E+07
4	1.41E+01	4.23E+03	5.57E+02	9.52E+02	9.45E+02
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	2.71E-02	8.15E+01	9.81E+00	9.65E+00	1.44E+01
7	1.54E-01	3.60E+01	1.11E+01	1.27E+01	1.03E+01
8	2.03E+01	2.05E+01	2.04E+01	2.04E+01	5.09E-02
9	4.45E-01	6.53E+00	3.79E+00	3.68E+00	1.45E+00
10	3.95E-02	9.57E-01	3.25E-01	3.71E-01	2.00E-01
11	0.00E+00	4.97E+00	9.95E-01	1.56E+00	1.40E+00
12	3.98E+00	2.59E+01	1.19E+01	1.23E+01	4.93E+00
13	5.31E+00	4.44E+01	2.31E+01	2.32E+01	1.01E+01
14	1.35E+01	4.72E+02	2.06E+02	2.09E+02	1.06E+02
15	1.58E+02	1.11E+03	5.48E+02	5.40E+02	2.33E+02
16	5.57E-01	1.61E+00	1.13E+00	1.12E+00	2.07E-01
17	6.29E-01	1.43E+01	1.13E+01	1.09E+01	2.62E+00
18	1.15E+01	3.65E+01	1.95E+01	2.15E+01	7.41E+00
19	1.64E-01	1.07E+00	5.81E-01	6.06E-01	1.94E-01
20	8.52E-01	3.53E+00	2.96E+00	2.80E+00	6.15E-01
21	3.00E+02	3.00E+02	3.00E+02	3.00E+02	0.00E+00
22	8.31E+00	5.61E+02	2.44E+02	2.35E+02	1.57E+02
23	6.88E+01	1.50E+03	6.67E+02	6.90E+02	3.11E+02
24	1.12E+02	2.21E+02	2.11E+02	2.07E+02	1.66E+01
25	1.18E+02	2.19E+02	2.04E+02	2.04E+02	1.33E+01
26	1.04E+02	2.00E+02	1.15E+02	1.41E+02	4.25E+01
27	3.02E+02	5.91E+02	3.35E+02	3.66E+02	7.17E+01
28	3.00E+02	7.79E+02	3.00E+02	3.23E+02	9.34E+01

Table 3: Results for D = 30

Function	Best	Worst	Median	Mean	Std. Dev.
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	8.22E+05	5.09E+06	2.35E+06	2.66E+06	1.12E+06
3	9.86E+04	6.70E+07	6.85E+06	9.42E+06	1.22E+07
4	9.81E+03	2.71E+04	1.48E+04	1.55E+04	3.93E+03
5	0.00E+00	1.88E-08	0.00E+00	3.69E-09	5.92E-09
6	1.50E+01	8.18E+01	1.69E+01	3.61E+01	2.80E+01
7	1.75E+00	3.04E+01	8.53E+00	9.77E+00	6.34E+00
8	2.08E+01	2.10E+01	2.10E+01	2.09E+01	5.18E-02
9	9.17E+00	2.32E+01	1.45E+01	1.48E+01	3.04E+00
10	3.95E-02	2.64E-01	9.12E-02	1.02E-01	4.68E-02
11	3.98E+00	2.09E+01	1.19E+01	1.24E+01	3.97E+00
12	2.19E+01	5.67E+01	3.58E+01	3.65E+01	8.07E+00
13	1.97E+01	1.20E+02	7.50E+01	7.32E+01	2.13E+01
14	2.07E+02	1.21E+03	6.79E+02	7.10E+02	1.94E+02
15	2.15E+03	7.24E+03	6.70E+03	6.43E+03	1.01E+03
16	1.58E+00	2.99E+00	2.55E+00	2.50E+00	2.82E-01
17	3.76E+01	6.18E+01	4.84E+01	4.92E+01	5.60E+00
18	1.68E+02	2.19E+02	2.03E+02	2.02E+02	9.98E+00
19	1.68E+00	3.71E+00	2.64E+00	2.63E+00	4.87E-01
20	1.02E+01	1.24E+01	1.15E+01	1.15E+01	3.92E-01
21	2.00E+02	4.43E+02	3.00E+02	2.77E+02	7.28E+01
22	2.22E+02	1.47E+03	5.91E+02	6.36E+02	2.46E+02
23	1.98E+03	7.20E+03	6.43E+03	5.35E+03	1.86E+03
24	2.10E+02	2.42E+02	2.23E+02	2.24E+02	8.30E+00
25	2.40E+02	2.84E+02	2.58E+02	2.59E+02	9.05E+00
26	2.00E+02	3.24E+02	2.00E+02	2.03E+02	1.73E+01
27	3.75E+02	7.49E+02	5.21E+02	5.64E+02	1.04E+02
28	3.00E+02	3.00E+02	3.00E+02	3.00E+02	0.00E+00

Table 4: Results for D = 50

Function	Best	Worst	Median	Mean	Std. Dev.
1	3.81E-07	5.12E-06	1.65E-06	1.90E-06	9.71E-07
2	3.09E+06	1.43E+07	7.25E+06	7.57E+06	2.43E+06
3	3.65E+06	3.23E+08	6.88E+07	8.85E+07	7.72E+07
4	2.24E+04	5.36E+04	3.98E+04	3.96E+04	6.33E+03
5	1.13E-04	5.76E-04	2.89E-04	2.86E-04	9.66E-05
6	4.34E+01	4.92E+01	4.68E+01	4.68E+01	1.37E+00
7	4.44E+00	4.60E+01	2.15E+01	2.22E+01	8.82E+00
8	2.11E+01	2.12E+01	2.11E+01	2.11E+01	3.26E-02
9	1.58E+01	3.66E+01	2.65E+01	2.60E+01	4.90E+00
10	8.09E-01	3.31E+00	1.50E+00	1.65E+00	5.29E-01
11	2.15E+01	5.89E+01	3.79E+01	3.88E+01	8.15E+00
12	4.88E+01	3.26E+02	7.66E+01	8.66E+01	4.95E+01
13	1.08E+02	3.89E+02	1.80E+02	2.32E+02	1.00E+02
14	6.63E+02	2.57E+03	1.24E+03	1.26E+03	4.05E+02
15	1.19E+04	1.42E+04	1.37E+04	1.36E+04	4.94E+02
16	2.48E+00	3.77E+00	3.37E+00	3.31E+00	2.76E-01
17	8.08E+01	1.65E+02	1.13E+02	1.14E+02	1.50E+01
18	3.77E+02	4.42E+02	4.15E+02	4.14E+02	1.65E+01
19	3.68E+00	8.50E+00	5.32E+00	5.49E+00	9.59E-01
20	2.07E+01	2.22E+01	2.17E+01	2.16E+01	2.78E-01
21	2.00E+02	1.13E+03	7.96E+02	6.43E+02	4.10E+02
22	5.93E+02	2.12E+03	1.32E+03	1.27E+03	3.63E+02
23	1.14E+04	1.43E+04	1.34E+04	1.34E+04	5.72E+02
24	2.22E+02	2.83E+02	2.52E+02	2.50E+02	1.34E+01
25	2.83E+02	3.36E+02	3.06E+02	3.06E+02	1.22E+01
26	2.00E+02	3.80E+02	3.48E+02	2.83E+02	7.86E+01
27	6.00E+02	1.17E+03	9.63E+02	9.42E+02	1.27E+02
28	4.00E+02	3.49E+03	4.00E+02	4.61E+02	4.33E+02

References

- [1] Y. Gonzalez-Fernandez and S. Chen. (2015) "Leaders and Followers – A New Metaheuristic to Avoid the Bias of Accumulated Information." Proc. 2015 IEEE Congress on Evolutionary Computation, pp 776-783. IEEE Press.
- [2] J.J. Liang, B.Y. Qu, P.N. Suganthan, A.G. Hernández-Díaz, "Problem Definitions and Evaluation Criteria for the CEC 2013 Special Session on Real-Parameter Optimization," Technical Report, Nanyang Technological University, Singapore, January 2013.