

CENTRAL WASHINGTON UNIVERSITY

OPTIMIZATION

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Project 1 Report

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1 Introduction

For this assignment, we were asked to experiment simulating 18 standard benchmark functions of different properties. Those functions are Schwefel, De Jong 1, Rosenbrock's Saddle, Rastrigin, Griewangk, Sine Envelope Sine Wave, Stretch V Sine Wave, Ackley One, Ackley Two, Egg Holder, Rana, Pathological, Michalewicz, Master's Cosine Wave, Quartic, Levy, Step and Alpine. The goal was to observe for each function, how close to its global optima we could get by solving it using Monte Carlo techniques. Therefore, for each function we generated multiple vectors (90) of pseudo random numbers (using Mersenne Twister) and of 3 different dimensions(10, 20, 30) and passed them to the function one at the time while recording the results (fitness) each time. We performed a statistical analysis on the results we obtained and the outcome is described in the next section.

2 Results

Table 1: Statistics for each function (dimension = 10)

function	Average	Std.Dev	Range	Median	Time
Schwefel	4283.638	494.9550998	2308.18	4204.76	0.157
De Jong 1	33089.2133333333	5982.250116	24670.7	33481.25	0.071
Rosenbrock	17608329333.3333	4785879607.43	18981610000	17723100000	0.088
Rastrigin	298208.833333333	53597.852191	218767	299582.5	0.109
Griewangk	207.807433333333	37.3891692557	154.192	210.258	0.117
Sine Envelope	-4.48550966666667	1.1560828184	4.69342	-4.45479	0.169
Stretch V Sine	3.14885	0	0	3.14885	0.105
Ackley One	181.847366666667	18.76554	73.783	183.498	0.116
Ackley Two	181.742333333333	7.7985926	33.699	183.106	0.14
Egg Holder	-27.3037533333334	903.71623	3554.81	-153.5975	0.101
Rana	94.1003833333333	641.32826	2243.06	175.601	0.16
Pathological	4.21475233333333	0.769448	3.4947	4.492165	0.112
Michalewicz	-1.18668163333333	0.6353523	2.268685	-1.08452	0.186
Masters' Cosine	-4.86272	0	0	-4.86272	0.106
Quartic	1129954966.66667	458761279.35	1664917000	1073065000	0.159
Levy	11589.6813333333	5467.2745217	23630.6	11293.25	0.186
Step	30382.47	4760.3707363	17312.8	30500.85	0.072
Alpine	280.1586	58.62958033	224.441	291.1945	0.078

Table 2: Statistics for each function (dimension = 20)

function	Average	Std.Dev	Range	Median	Time
Schwefel	8469.37766666667	722.92524	3056.12	8338.535	0.118
De Jong 1	63096.4966666667	9767.0119	42558.7	63488.55	0.057
Rosenbrock	34865516666.6667	7929547146.96	38379900000	35711800000	0.087
Rastrigin	1135525.53333333	176040.165	772508	1140705	0.116
Griewangk	395.3531	61.0438051	265.992	397.8035	0.154
Sine Envelope	-9.96001333333333	1.58812826	7.30569	-9.722965	0.199
Stretch V Sine	6.64758	0	0	6.64758	0.2
Ackley One	374.232833333333	34.8422094	140.14	374.2865	0.06
Ackley Two	382.6739	13.4719138	48.635	383.442	0.083
Egg Holder	294.970266666667	1248.54406	4885.07	286.9655	0.059
Rana	127.088606666667	769.1705668	3104.01	380.8865	0.1
Pathological	8.92762933333333	0.910227378	3.88566	9.20033	0.062
Michalewicz	-2.29808193	1.126899208	5.1339641	-2.18149	0.11
Masters' Cosine	-10.2657	0	0	-10.2657	0.056
Quartic	4069130000	1078980112.42	4767720000	4096895000	0.062
Levy	24877.7966666667	8657.441526	45741.5	25381.3	0.066
Step	60780.8633333333	9397.8886986	42134.6	61260.9	0.02
Alpine	587.351333333333	96.154026404	393.406	586.1425	0.035

Table 3: Statistics for each function (dimension = 30)

function	Average	Std.Dev	Range	Median	Time
Schwefel	12813.65	733.93873	3195.7	12992.7	0.057
De Jong 1	95843.0466666667	13815.41690	60202.3	96594.4	0.03
Rosenbrock	53646780000	12818067409.9	49701800000	53175400000	0.043
Rastrigin	2584870.66666667	373495.438571	1617080	2616670	0.077
Griewangk	600.019033333333	86.34614216	376.262	604.715	0.082
Sine Envelope	-15.16765	2.3984072933	8.9231	-15.341	0.1
Stretch V Sine	10.1463	0	0	10.1463	0.07
Ackley One	572.734366666667	51.0948993	226.316	571.4805	0.082
Ackley Two	583.923133333333	15.4512797	53.671	588.041	0.113
Egg Holder	236.7915	1667.8102771	6632.31	192.5345	0.154
Rana	270.114989333333	826.91904560	2986.409	169.82954	0.15
Pathological	13.6565633333333	1.0332884183	4.3248	13.91615	0.164
Michalewicz	-3.43252033333333	1.1152965712	4.44007	-3.54023	0.157
Masters' Cosine	-15.6688	0	0	-15.6688	0.078
Quartic	8758279666.66667	2032056263.2	8108290000	8693130000	0.116
Levy	39016.0066666667	13153.486027	64329.4	37431.25	0.088
Step	93851.8833333333	14756.100701	64393.2	93868.7	0.017
Alpine	902.070433333333	136.08823505	566.02	900.95	0.044

3 Results Analysis

When analyzing the results above, we can see that the fitness we obtained for most functions using Monte Carlo techniques, is nowhere near their global optima. That's the case for functions such as Schwefel, De Jong 1, Step etc... However, the experimentation also produced some good results for few functions which are Sine envelope, Stretch V Sine Wave etc...

4 Conclusion

Since we obtained a bad fitness in average for each function during the experimentation, we can conclude that using Monte Carlo is a bad approach to optimize the standard benchmark functions that were provided to us.