Function Evaluations Upto 1e+12 and Large Population Sizes Assessed in Distance-based Success History Differential Evolution for 100-Digit Challenge and Numerical Optimization Scenarios (DISHchain1e+12)

A competition entry for "100-Digit Challenge, and Four Other Numerical Optimization Competitions"

at The Genetic and Evolutionary Computation Conference (GECCO) 2019

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ABSTRACT

This paper describes a competition entry for the "100-Digit Challenge, and Four Other Numerical Optimization Competitions" at The Genetic and Evolutionary Computation Conference (GECCO) 2019, by assessing the function evaluations up to 1e+12, and large population sizes in Distance-based Success History Differential Evolution for the 100-Digit Challenge and Numerical Optimization Scenarios (DISHchain1e+12).

CCS CONCEPTS

• **Mathematics of computing** → **Evolutionary algorithms**; *Bio-inspired optimization*; Nonparametric statistics; • **Theory of computation** → **Nonconvex optimization**; **Bio-inspired optimization**; *Stochastic control and optimization*; • **Computing methodologies** → *Continuous space search*; • **General and reference** → *Evaluation*; *Performance*;

KEYWORDS

continuous optimization, 100-digit challenge, large population size, Differential Evolution, DISH

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1 INTRODUCTION

This paper describes the competition entry results, obtained using a population-based optimization algorithm for the 100-Digit Challenge [1]. The optimization algorithm applied is the recent DISH algorithm, Distance-based Success History Differential Evolution [2], which is now tailored for a longer execution time and uses large populations, hence, the algorithm is named DISHchain1e+12. The approach to tuning is presented in the next section, then the results in Section 3, followed by the conclusion in Section 4.

2 RELATED WORK

The 100-Digit Challenge for some optimization algorithm measures the number of runs that attain correct digits' precision successfully for 10 optimization problems selected in [1]. As the 100-Digit Challenge allows tuning of two control parameters per problem type using the applied algorithm, the following two aspects are considered, as explained in the next Section.

3 TUNED ASPECTS: FUNCTION EVALUATIONS AND POPULATION SIZE

First, the number of function evaluations was considered with different functions. An approach of execution time tenfolding [3, 5] the number of evaluations was applied until the problem was reported as solved to a planned precision [4, 5]. Besides that, large population sizes were considered for some functions. The parameter settings used are listed in Table 1. All other parameters were used as originally applied in the DISH algorithm [2], which is the basis for the DISHchain1e+12algorithm. The implementation language was C++.

4 RESULTS

As the 100-Digit Challenge requires reporting the number of correct digits of the 10 functions, these are listed in Table 2. For all but one function, the DISHchain1e+12algorithm yields a perfect score, as measured by [1]. Over all functions, an aggregate result of 96 is reported as the final score of the 100-Digit Challenge for DISHchain1e+12. The evolution of runs is seen in Figure 1.

Table 1: Tuned parameter values for the DISHchain1e+12 algorithm.

Function	*MAX_FES*	NP_0
1	1e+5	$25\sqrt{D}\log D$
2	1e+6	$25\sqrt{D}\log D$
3	1e+7	$25\sqrt{D}\log D$
4	1e+8	$250\sqrt{D}\log D$
5	1e+6	$25\sqrt{D}\log D$
6	1e+5	$25\sqrt{D}\log D$
7	1e+8	$2500\sqrt{D}\log D$
8	1e+11	$10000\sqrt{D}\log D$
9	1e+12	$25\sqrt{D}\log D$
10	1e+7	$25\sqrt{D}\log D$

Table 2: Fifty runs for each function sorted by the number of correct digits (for the DISHchain1e+12 algorithm).

Function	**Number of correct digits**											Score
	0	1	2	3	4	5	6	7	8	9	10	
1	50	50	50	50	50	50	50	50	50	50	50	10
2	50	50	50	50	50	50	50	50	50	50	50	10
3	50	50	50	50	50	50	50	50	50	50	50	10
4	50	50	50	50	50	50	50	50	50	50	50	10
5	50	50	50	50	50	50	50	50	50	50	50	10
6	50	50	50	50	50	50	50	50	50	50	50	10
7	50	50	50	50	50	50	50	50	50	50	50	10
8	50	50	50	50	50	50	50	50	50	50	50	10
9	50	50	50	50	50	47	25	11	7	6	4	6
10	50	50	50	50	50	50	50	50	50	50	50	10
										Total:		**96**

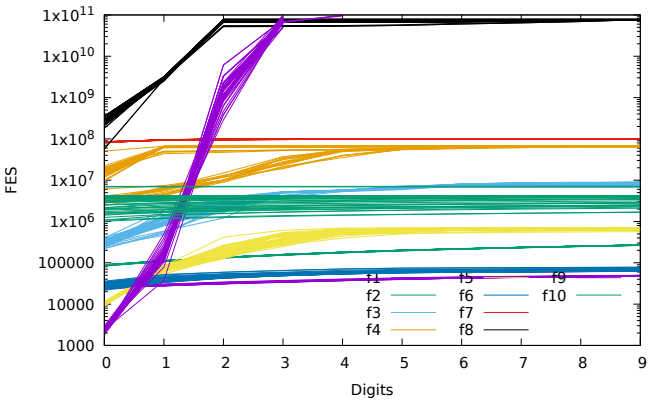

Figure 1: Function evaluations to reach accuracy up to a certain digit (combined on all functions 1–10, with same line type per function), using a log scale axis for FES.

5 CONCLUSIONS

This paper presented the DISHchain1e+12algorithm results on the 100-Digit Challenge, yielding a score of 96. The population size and number of function evaluations were tuned for different functions, enabling that the perfect scores were obtained in nine out of ten test functions. In future work, the results could be further improved with a modified algorithm that uses an even higher number of function evaluations, specifically considering parallellization frameworks for the programming implementations.

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