

# Computational Load Analysis

## 1. Analysis of Computational Load in Big-O Notation

The computational load of CLPSO (In Big-O notation):

Initialization:  $O(ND)$

Evaluate:  $O(ND)$

Update:  $O(ND)$

Overall:  $O(ND)$

The computational load of ML-CLPSO-AM

Initialization:  $O(ND) + O(N^2) = O(ND + N^2)$

Evaluate:  $O(ND)$

Update:  $O(ND) + O(N^2) + O(D) = O(ND + N^2)$

Overall:  $O(ND + N^2)$

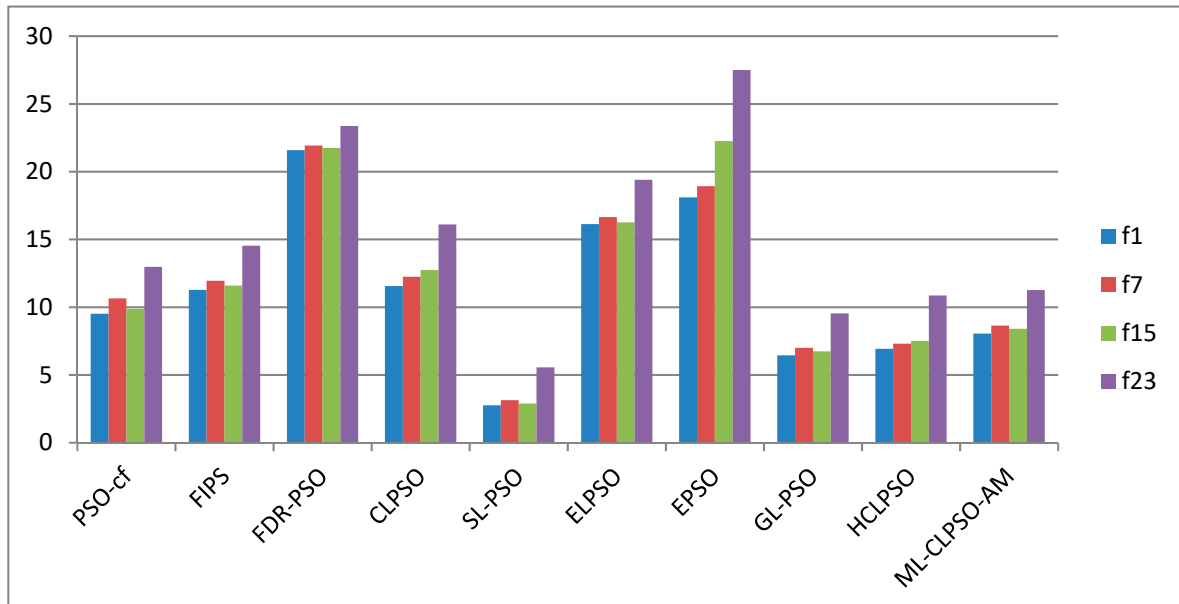
The computational load of Multi-leader strategy:  $O(N^2)$

The computational load of adaptive mutation strategy:  $O(D)$

Note:  $N, D$  denote for the swarm size and the dimensionality, respectively.

Discussion: In most of the cases,  $N$  and  $D$  have the same order of magnitudes. Hence the computational loads of ML-CLPSO-AM and CLPSO are almost the same.

## 2. Comparison of Computing Time on CEC 2017 Functions



**Figure S1.** Mean computing time of PSO algorithms (Unit: Second).

The experiment of computing time is carried out on PC with Intel i7-4790 CPU, Win7 Ultimate 64-bit OS, Matlab R2014b. Each algorithm is run for 51 indecent runs and the mean computing times are given in Figure S1.

Discussion: Figure S1 shows that the computing time of ML-CLPSO-AM is shorter than PSO-cf, FIPS, FDR-PSO, CLPSO, EL-PSO and EPSO, longer than SL-PSO, GL-PSO and HCLPSO.

With multi-leader and adaptive mutation strategies, ML-CLPSO-AM can search the potential promising area efficiently, its computing time is shorter than CLPSO.