CEC 2017 Special Session on Single Objective Numerical Optimization Single Bound Constrained Real-Parameter Numerical Optimization

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Topics Outline

- Introduction
- A review for newly CEC'17 benchmark problems
- Accepted Algorithms
- Evaluation Criteria
- Ranking and winners

Introduction

- Research on the single objective optimization algorithms is the basis of the research on the more complex optimization algorithms

- In the recent years, various kinds of novel optimization algorithms have been proposed to solve real-parameter optimization problems

- CEC test suits benchmark problems held under IEEE congress on Evolutionary Computation (CEC) conference series are among the widely used benchmarks which have attracted many researchers to use for testing their developed algorithms
  - CEC'05, CEC'13, CEC'14 special session on real-parameter optimization

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A review for newly CEC'17 benchmark problems

- For this competition, we developed benchmark problems with several novel features such as:
  - new basic functions, composing 3, 4, 5 and 6 test problems by extracting features dimension-wise from several problems and rotated trap problems

- CEC'14 test suite Part A- including 30 benchmark functions http://www.ntu.edu.sg/home/EPNSugan/index_files/CEC2017

- Details of the CEC'17 test suite with the C and Matlab codes can be downloaded from the above website
  - Noor H. Awad, Mostafa Z. Ali, J.J. Liang, B.Y. Qu, Ponnuthurai N. Suganthan, "Problem Definitions and Evaluation Criteria for the CEC 2017 Special Session and Competition on Single Objective Real-Parameter Numerical Optimization," Nanyang Technological University, Jordan University of Science and Technology and Zhengzhou University, Tech. Rep., 2016.

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- CEC'14 test suite Part A- including 30 benchmark functions http://www.ntu.edu.sg/home/EPNSugan/index_files/CEC20147

- Details of the CEC'17 test suite with the C and Matlab codes can be downloaded from the above website
  - Noor H. Awad, Mostafa Z. Ali, J.J. Liang, B.Y. Qu, Ponnuthurai N. Suganthan, "Problem Definitions and Evaluation Criteria for the CEC 2017 Special Session and Competition on Single Objective Real-Parameter Numerical Optimization," Nanyang Technological University, Jordan University of Science and Technology and Zhengzhou University, Tech. Rep., 2016.

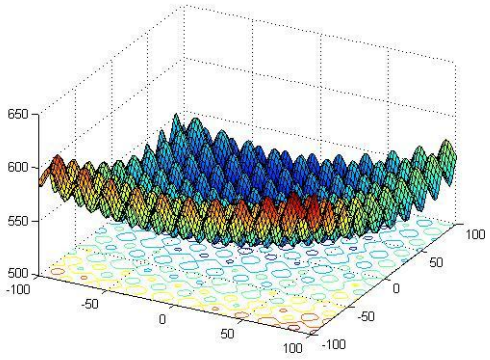
A review for newly CEC'17 benchmark problems

- CEC'17 consists of 30 problems → 3 Unimodal + 7 Multimodal+ 10 Hybrid + 10 Composition functions

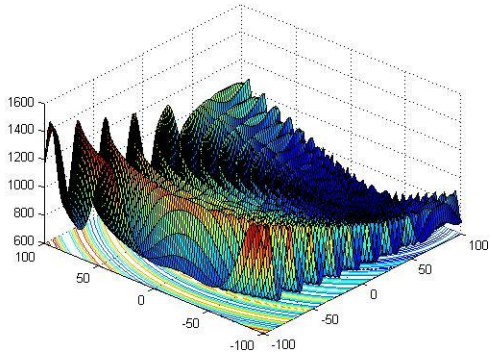
- Unimodal Functions:
  - Shifted and Rotated Bent Cigar Function
  - Shifted and Rotated Sum of Different Power Function
  - Shifted and Rotated Zakharov Function

- Multimodal Functions:
  - Shifted and Rotated Rosenbrock's Function
  - Shifted and Rotated Rastrigin's Function
  - Shifted and Rotated Expanded Scaffer's F6 Function
  - Shifted and Rotated Lunacek Bi_Rastrigin Function
  - Shifted and Rotated Non-Continuous Rastrigin's Function
  - Shifted and Rotated Levy Function
  - Shifted and Rotated Schwefel's Function

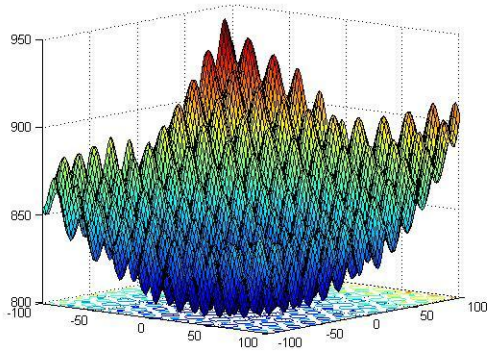
A review for newly CEC'17 benchmark problems



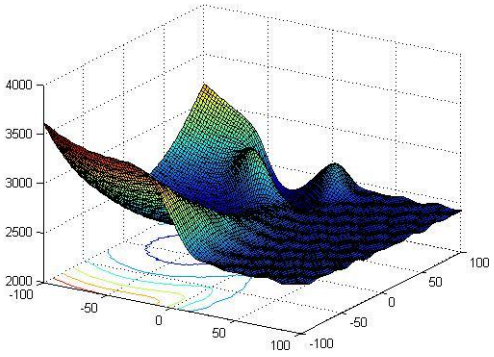
3-D map for Shifted and Rotated Rastrigin's Function (F5)



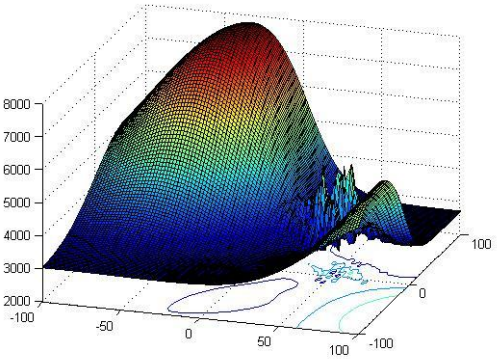
3-D map for Shifted and Rotated Expanded Scaffer's (F6)



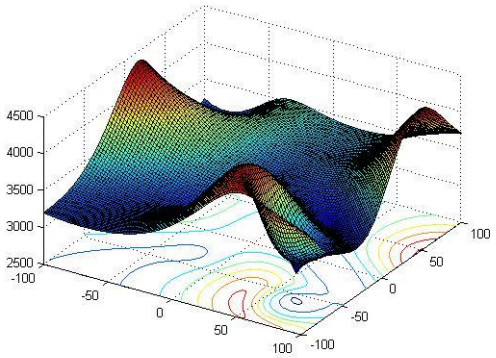
3-D map for Shifted and Rotated Non-Continuous Rastrigin's Function (F8)



3-D map for Composition Function 2 (N=3) (F22)



3-D map for Composition function (N=5) (F26)



3-D map for Composition function (N=6) (F28)

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Accepted Algorithms

- 11 Algorithms were accepted

	ID	Algorithm	Paper Title
1	17315	jSO	Single Objective Real-Parameter Optimization Algorithm jSO
2	17321	MM_OED	Multi-method based Orthogonal Experimental Design Algorithm for Solving CEC2017 Competition Problems
3	17322	IDEbestNsize	Enhanced Individual-dependent Differential Evolution with Population Size Adaptation
4	17343	RB-IPOP-CMA-ES	A Version of IPOP-CMA-ES Algorithm with Midpoint for CEC 2017 Single Objective Bound Constrained Problems
5	17051	LSHADE_SPACMA	LSHADE with Semi-Parameter Adaptation Hybrid with CMA-ES for Solving CEC 2017 Benchmark Problems
6	17420	DES	A Differential Evolution Strategy

Accepted Algorithms

	ID	Algorithm	Paper Title
7	17543	DYYPO	Dynamic Yin-Yang Pair Optimization and its Performance on Single Objective Real Parameter Problems of CEC 2017
8	17544	TLBO-FL	Teaching Learning Based Optimization with Focused Learning and its Performance on CEC2017 functions
9	17447	PPSO	Proactive Particles in Swarm Optimization: a Settings-Free Algorithm for Real-Parameter Single Objective Optimization Problems
10	17260	MOS-SOCO2011/13	A comparison of three large-scale global optimizers on the CEC 2017 single objective real parameter numerical optimization benchmark
11	17106	LSHADE-*cn*EpSin	Ensemble Sinusoidal Differential Covariance Matrix Adaptation with Euclidean Neighborhood for Solving CEC2017 Benchmark Problems
12	17411	EBOwithCMAR	Improving the local search capability of Effective Butterfly Optimizer using Covariance Matrix Adapted Retreat phase

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Evaluation Criteria

- The evaluation method for each algorithm is based on a score of 100 which is based on two criteria as follows taking into account higher weights will be given for higher dimensions:
  1. 50% summation of error values for all dimensions as follows:

$$SE = 0.1 \times \sum_{i=1}^{30} ef_{10D} + 0.2 \times \sum_{i=1}^{30} ef_{30D} + 0.3 \times \sum_{i=1}^{30} ef_{50D} + 0.4 \times \sum_{i=1}^{30} ef_{100D}$$

$$Score1 = (1 - \frac{SE - SE_{\min}}{SE}) \times 50$$

  2. 50% rank based for each problem in each dimension as follows:

$$SR = 0.1 \times \sum_{i=1}^{30} rank_{10D} + 0.2 \times \sum_{i=1}^{30} rank_{30D} + 0.3 \times \sum_{i=1}^{30} rank_{50D} + 0.4 \times \sum_{i=1}^{30} rank_{100D}$$

$$Score2 = (1 - \frac{SR - SR_{\min}}{SR}) \times 50$$

  3. Combine the above two parts to find the final score as follows → $Score = Score1 + Score2$

- F2 has been excluded because it shows unstable behavior especially for higher dimensions, and significant performance variations for the same algorithm implemented in Matlab, C

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Ranking

Algorithm name	Score 1	Score 2	Final Score	Rank
jSO	**4.9689E+01**	**4.7076E+01**	**9.6765E+01**	**2**
MM_OED	4.5956E+01	4.0116E+01	8.6073E+01	6
IDEbestNsize	2.9850E+01	2.7679E+01	5.7529E+01	7
RB-IPOP-CMA-ES	3.7925E+00	3.3612E+01	3.7404E+01	7
LSHADE_SPACMA	4.6438E+01	5.0000E+01	9.6438E+01	4
DES	4.5935E+01	4.3202E+01	8.9137E+01	5
DYYPO	5.9337E-01	1.7031E+01	1.7624E+01	12
TLBO-FL	2.8731E-02	1.6246E+01	1.6275E+01	13
PPSO	3.9254E+00	1.7355E+01	2.1281E+01	11
MOS-SOCO2011	1.1085E+01	1.9305E+01	3.0390E+01	10
MOS-SOCO2013	1.8942E+01	1.7343E+01	3.6285E+01	9
LSHADE-*cn*EpSin	**4.6816E+01**	**4.9743E+01**	**9.6558E+01**	**3**
EBOwithCMAR	**5.0000E+01**	**4.8012E+01**	**9.8012E+01**	**1**

Questions

Thank you for your listening