YIN-YANG-PAIR OPTIMIZATION

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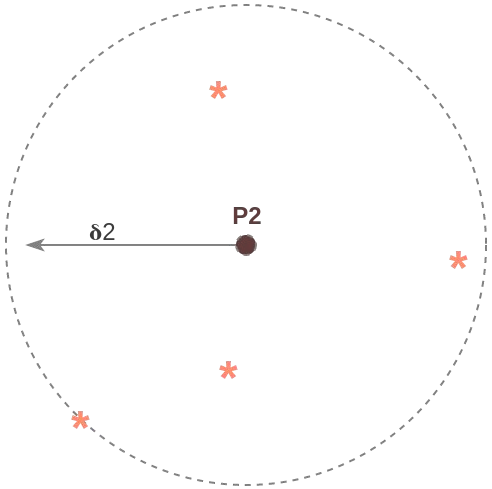
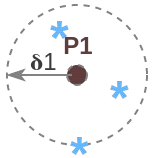
MOTIVATION

- Exploitation - Exploration balance
- Same navigation mechanism
- Low complexity

KEY VALUES
δ - Initial radius
α - Transformation speed





MAIN FEATURES

TWO POINTS		RADII	α FACTOR
P1 exploitates	→	δ1 shrinks	$\delta_1 = d_1 - (d_1/\alpha)$
P2 explores	→	δ2 grows	$\delta_2 = d_2 - (d_2/\alpha)$

If fitter they exchange positions and radius

MAIN FEATURES

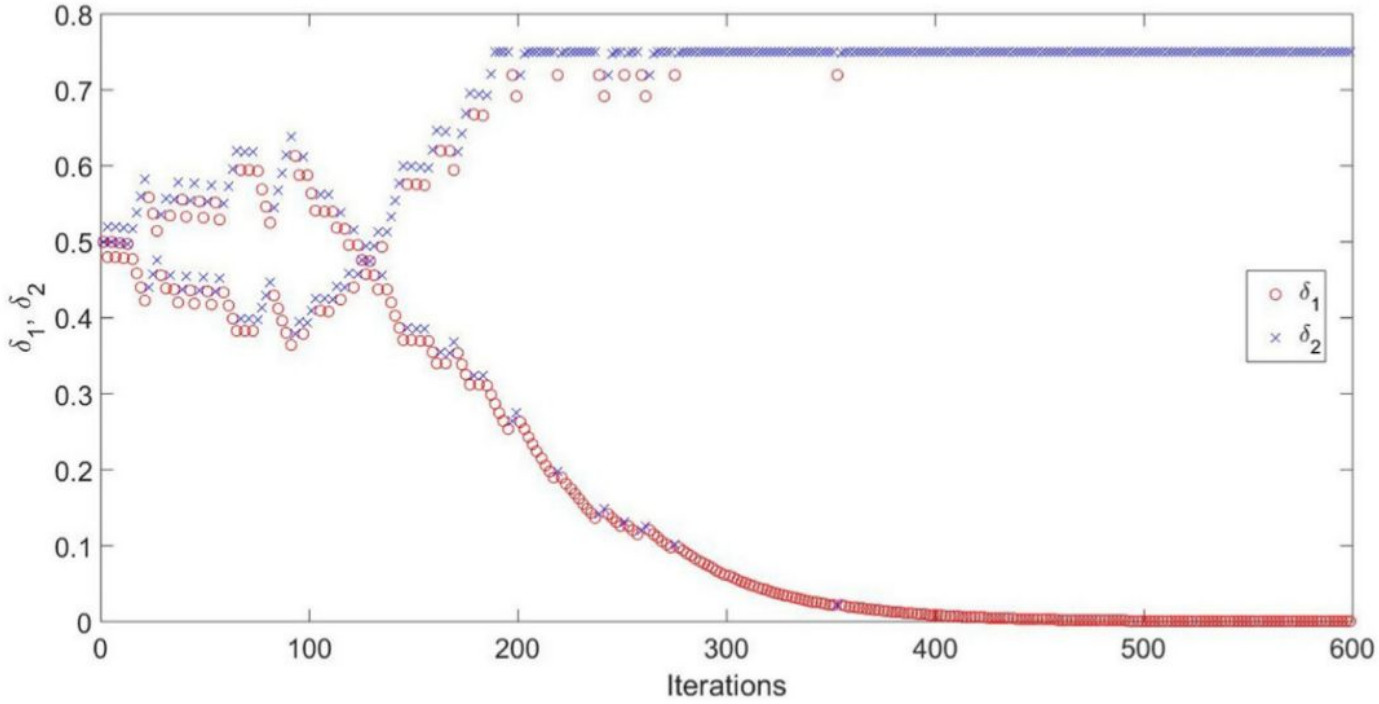


Fig. 3. Variation of δ_1 and δ_2 with iterations.

KEY VALUES
***l* - Archive stage interval**

MAIN FEATURES

SPLITTING STAGE

Saves in the archive the current solution

Generates 2D new solutions for each point

Selects the fittest

l iterations

ARCHIVE STAGE

Selects the two fittest solutions from the archive (last 2*l* points)

Every *l* iterations

Reduces δ

KEY VALUES
***P* - Splitting probability (0.5)**

NAVIGATION MECHANISM

ONE-WAY SPLITTING

Explore the hypersphere in 1 dimension

NP = Matrix 2DxD

$$NP_j^j = P^j + r\delta \quad and$$
$$NP_{D+j}^j = P^j - r\delta, \quad where\ j = 1,2,3\ldots D$$

D-WAY SPLITTING

Explore the hypersphere in several dimensions

B = Matrix 2DxD

$$NP_k^j = P^j + r\left(\delta/\sqrt{2}\right) \quad if\ B(k,j) = 1,$$
$$NP_k^j = P^j - r\left(\delta/\sqrt{2}\right) \quad else.$$
$$where\ k = 1,2,3\ldots 2D\ and\ j = 1,2,3\ldots D$$

NAVIGATION MECHANISM

Rastrigin function

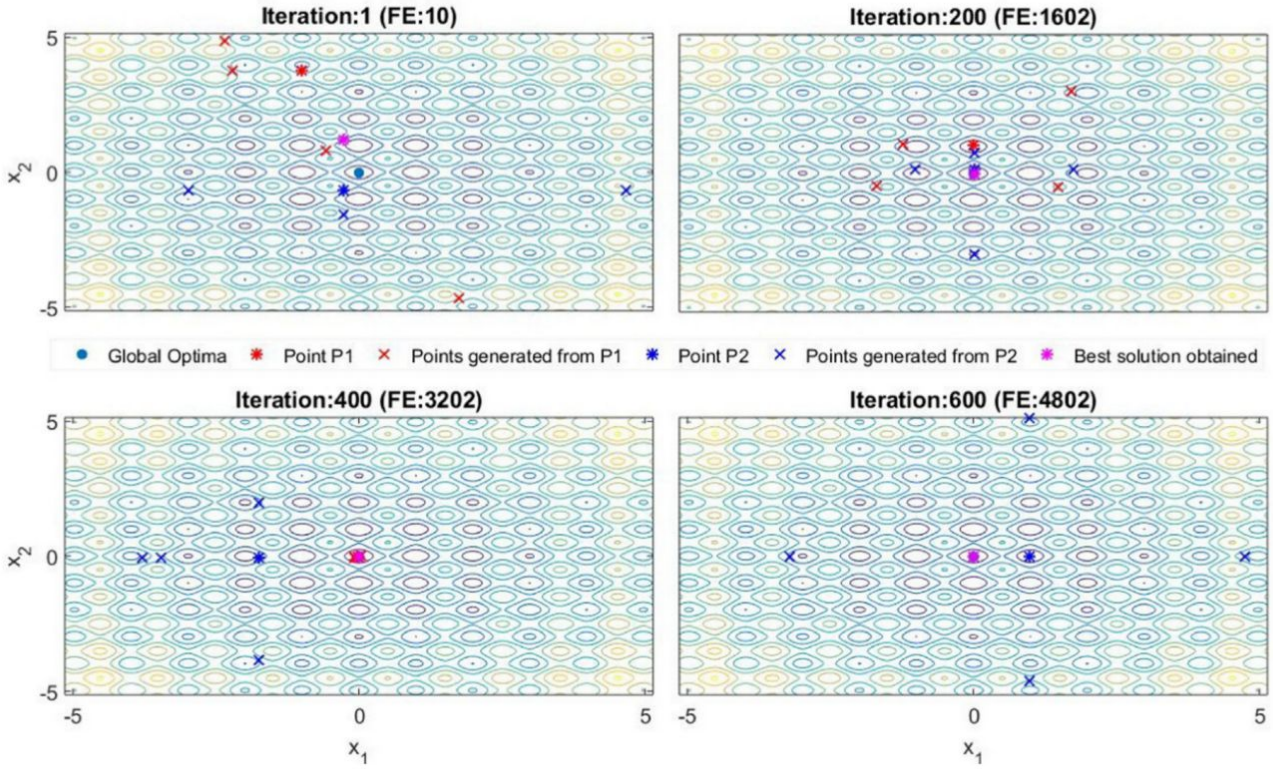
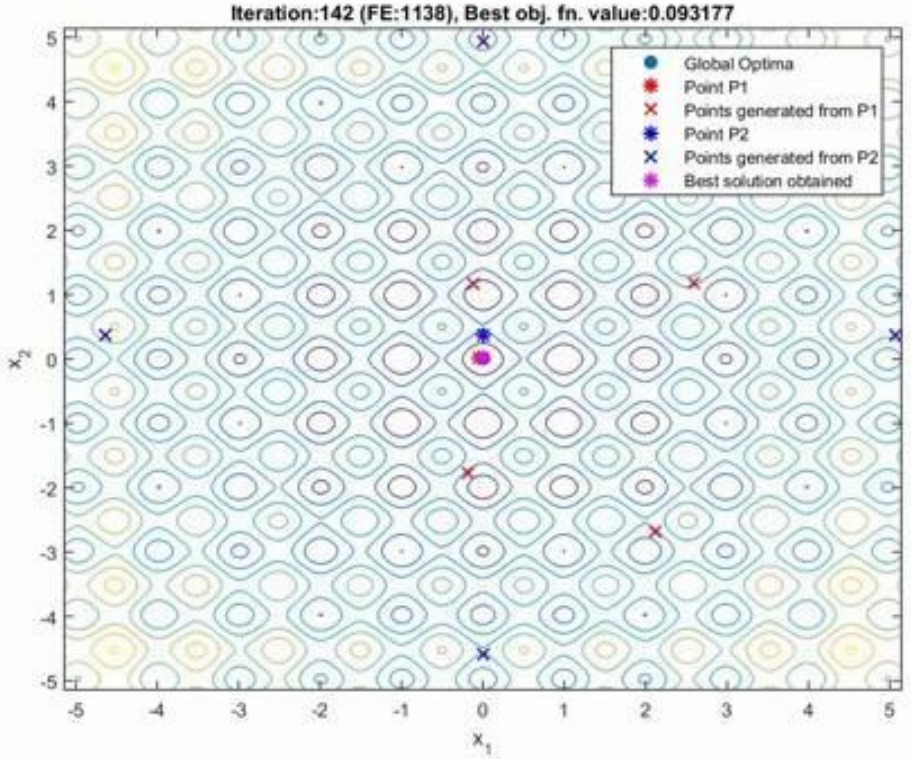
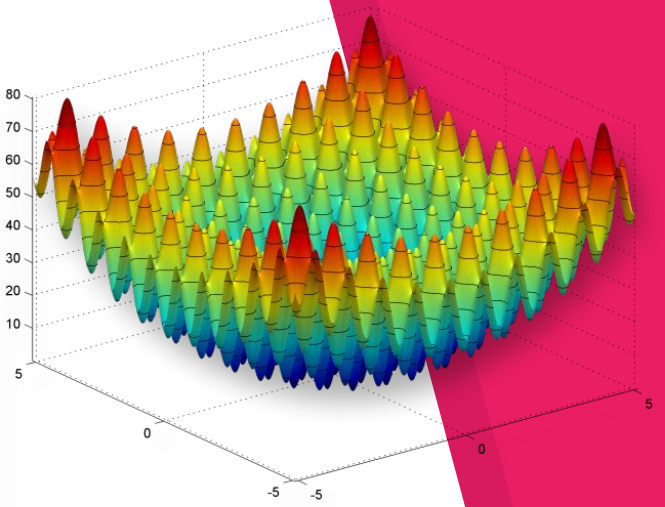


Fig. 2. Convergence of YYPO for the Rastrigin function.

NAVIGATION MECHANISM

Rastrigin function





CEC-2013 Results

Performance of YYPO on the 50*D* test functions.

	Prob. ID (Optima)	Best	Worst	Median	Mean	Std. dev.
Unimodal	CEC1 (−1400)	2.82E−08	6.57E−07	1.12E−07	1.45E−07	1.21E−07
	CEC2 (−1300)	1.13E+06	7.26E+06	3.69E+06	3.55E+06	1.48E+06
	CEC3 (−1200)	1.21E+07	2.51E+09	3.38E+08	5.43E+08	6.10E+08
	CEC4 (−1100)	1.83E+03	1.25E+04	4.55E+03	5.40E+03	2.63E+03
	CEC5 (−1000)	6.71E−04	4.43E−03	3.74E−03	3.58E−03	6.95E−04
Basic multimodal	CEC6 (−900)	4.34E+01	1.41E+02	4.72E+01	6.36E+01	2.80E+01
	CEC7 (−800)	5.75E+01	1.44E+02	1.04E+02	1.01E+02	2.07E+01
	CEC8 (−700)	2.10E+01	2.12E+01	2.11E+01	2.11E+01	2.98E−02
	CEC9 (−600)	2.77E+01	6.14E+01	4.50E+01	4.50E+01	7.51E+00
	CEC10 (−500)	4.17E−06	9.60E−02	2.96E−02	3.47E−02	2.13E−02
	CEC11 (−400)	3.57E−07	4.97E+00	1.99E+00	1.78E+00	1.18E+00
	CEC12 (−300)	1.63E+02	6.08E+02	3.69E+02	3.76E+02	1.22E+02
	CEC13 (−200)	2.53E+02	6.45E+02	4.07E+02	4.28E+02	8.82E+01
	CEC14 (−100)	1.59E+00	1.96E+01	1.01E+01	1.02E+01	3.84E+00
	CEC15 (100)	6.12E+03	1.07E+04	8.25E+03	8.29E+03	1.02E+03
	CEC16 (200)	9.67E−01	2.98E+00	1.79E+00	1.84E+00	4.37E−01
	CEC17 (300)	5.34E+01	6.26E+01	5.75E+01	5.77E+01	2.17E+00
	CEC18 (400)	2.03E+02	4.42E+02	3.24E+02	3.22E+02	6.49E+01
	CEC19 (500)	1.57E+00	4.20E+00	3.16E+00	3.10E+00	5.78E−01
	CEC20 (600)	1.93E+01	2.40E+01	2.10E+01	2.12E+01	1.08E+00
Composition	CEC21 (700)	2.00E+02	1.12E+03	8.36E+02	7.78E+02	3.94E+02
	CEC22 (800)	2.17E+01	2.45E+02	3.21E+01	8.78E+01	8.68E+01
	CEC23 (900)	7.21E+03	1.15E+04	9.34E+03	9.47E+03	1.04E+03
	CEC24 (1000)	2.64E+02	3.83E+02	3.28E+02	3.27E+02	2.47E+01
	CEC25 (1100)	3.23E+02	4.45E+02	3.91E+02	3.87E+02	2.74E+01
	CEC26 (1200)	2.00E+02	2.08E+02	2.00E+02	2.01E+02	1.29E+00
	CEC27 (1300)	1.02E+03	1.95E+03	1.56E+03	1.55E+03	2.00E+02
	CEC28 (1400)	4.00E+02	3.71E+03	4.00E+02	8.29E+02	1.09E+03

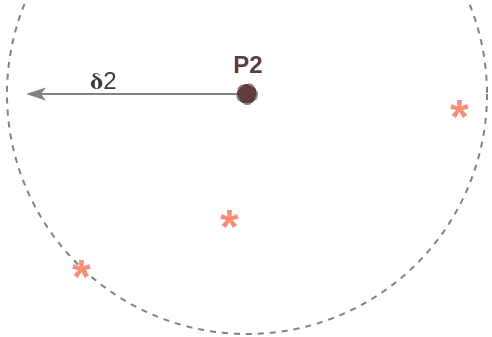
CEC-2013 Results

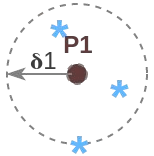
Wilcoxon signed rank test results.

YYPO vs.	10*D*			30*D*		
	R+	*R*−	*p*-Value	*R*+	*R*−	*p*-Value
ABC	235	171	4.66E−01	284	122	6.51E−02
ALO	400	6	7.26E−06	390	16	2.06E−05
DE	361	45	3.21E−04	319	87	8.25E−03
GWO	351	55	7.51E−04	307	99	1.79E−02
MDS	385	21	3.41E−05	361	45	3.21E−04
PS	393	13	1.51E−05	361	45	3.21E−04
PSO	388	18	2.52E−05	315	91	1.08E−02

YYPO vs.	50*D*		
	R+	*R*−	*p*-Value
ABC	284	122	6.51E−02
ALO	278	128	8.77E−02
DE	311	95	1.39E−02
GWO	318	88	8.83E−03
MDS	359	47	3.82E−04
PS	345	61	1.22E−03
PSO	324	82	5.86E−03

ABC Artificial Bee Colony
ALO Ant-Lion Optimizer
DE Differential Evolution
GWO Grey Wolf Optimizer
MDS Multiobjective Direct Search
PS Pattern Search
PSO Particle Swarm Optimization





ROOM FOR IMPROVEMENT

- Local search almost already implemented
- Dynamic splitting probability [1]

$$P_M = (D/(D+5))^2$$
$$P_U = 1 - P_M$$

- Dynamic load balance (P1/P2)
- Several explorer points
- Genetic stage before archive stage

[1] V. Punnathanam and P. Kotecha, "Adaptive Yin-Yang-Pair Optimization on CEC 2016 functions," 2016 IEEE Region 10 Conference (TENCON), Singapore, 2016, pp. 2296-2299.