

To spend more effort on regions with lower diversity improves MOEA/D

Using Diversity as a Priority Function for Resource Allocation on MOEA/D

Yuri Lavinas, Claus Aranha, Tetsuya Sakurai

1 Intro

- How to distribute effort given subproblem's difficulty?
- We estimate difficulty using priority functions.
- We distribute more effort to harder subproblems.

2 Methods

- 2-Norm vs. R.I. vs Random vs standard MOEA/D.
- UF functions set (100 dim), 21 repetitions, 70000 function evaluations, population size = 350.
- Analysis: IGD and proportion of non-dominated solutions.

3 Results

IGD	None	Norm	R.I.	Random
UF1	0.140 (0.013)	0.109 (0.016)	0.090 (0.012)	0.093 (0.014)
UF2	0.082 (0.006)	0.060 (0.005)	0.060 (0.005)	0.060 (0.004)
UF3	0.260 (0.012)	0.168 (0.025)	0.183 (0.335)	0.214 (0.030)
UF4	0.100 (0.023)	0.095 (0.002)	0.095 (0.003)	0.095 (0.002)
UF5	1.759 (0.080)	0.972 (0.056)	1.056 (0.064)	1.085 (0.073)
UF6	0.121 (0.027)	0.100 (0.016)	0.078 (0.014)	0.079 (0.016)
UF7	0.125 (0.018)	0.061 (0.006)	0.068 (0.005)	0.074 (0.005)
UF8	0.286 (0.012)	0.229 (0.014)	0.257 (0.020)	0.232 (0.006)
UF9	0.451 (0.012)	0.385 (0.020)	0.420 (0.017)	0.400 (0.018)
UF10	3.693 (0.200)	2.380 (0.241)	2.364 (0.272)	2.639 (0.253)
Non-dominated	None	Norm	R.I.	Random
UF	0.34 (0.04)	0.84 (0.06)	0.58 (0.10)	0.69 (0.05)

- In 6 of 10 functions 2-Norm had better results: lower IGD and higher rate of non-dominated.
- 2-Norm as priority function effectively improves the performance of MOEA/D.

Extra figures

Basic MOEA/D with only priority functions and no other variant. This algorithm is similar to the MOEA/D-DE with exception of lines 4 and 7.

Algorithm 1 MOEA/D with priority functions

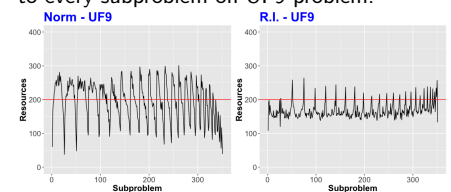
- 1: Initialize the weight vectors λ_i , the neighborhood B_i , the priority value u_i every subproblem $i = 1, \dots, N$.
- 2: **while** Termination criteria **do**
- 3: **for** 1 to N **do**
- 4: **if** $\text{rand}() < u_i$ **then**
- 5: Generate an offspring y for subproblem i .
- 6: Update the population by y .
- 7: Evaluate and after ΔT generations, keep updating u by a priority function.

2-Norm of the difference of current solutions and its parents.

Algorithm 1 2-Norm

- 1: Input: X^t decision vectors of solutions; X^{t-1} , decision vectors from the previous solutions; N, the population size.
- 2: **for** $i=1$ to N **do**
- 3: $u[i] = ||X_i^t - X_i^{t-1}||$
- 4: $u = \text{scale}(u)$ // between 0 and 1
- 5: **return** u

Amount of resources allocated by Norm, R.I. to every subproblem on UF9 problem.



- Norm as priority function forces solutions that are similar to update more often, leading to a higher exploration of the search space.
- To give higher priority for regions with lower diversity the algorithm spends more effort in regions that are not yet well explored.



← Download the paper