A fast and efficient multi-objective optimization algorithm

Dawei Zhan

***Abstract*—NSGA-II is very popular for solving multi-objective optimization problems. But its efficiency decreases gradually as the number of variables increases. In this work, we propose a novel multi-objective optimization algorithm to solve this problem. Numerical experiments show that our algorithm performs significantly better than NSGA-II on the test problems.**

I. Introduction

这是中文 这是楷体，目标函数 $f(\boldsymbol{x})$ 其中 $\boldsymbol{x}$ 是设计变量。

NSGA-II [1] is very popular for solving multi-objective optimization problems. Popular algorithms for multi-objective optimization problems are [1]–[3].

Section I gives the introduction. Section II introduces the backgrounds of this work.

II. Backgrounds

We have a scalar x, a vector $\boldsymbol{x}$, a random variable X, a matrix $\boldsymbol{X}$, where $\boldsymbol{x} = [x_1, x_2, \cdots, x_d]$, $\boldsymbol{X} = \{\boldsymbol{x}^{(1)}, \boldsymbol{x}^{(2)}, \cdots, \boldsymbol{x}^{(n)}\}$, where n n is the number of points.

we try to solve the following optimization problem in (1).

$$\text{minimize } f(\boldsymbol{x}) \tag{1}$$

The algorithm is given in Algorithm 1.

Algorithm 1 Algorithm of computing the maximum of two variables

Require: a, b
Ensure: $c = \max(a, b)$
  if $a > b$ **then**
    $c = a$
  else
    $c = b$
  end if

1) Step 1: see whether a is greater than b.
2) Step 2: if it is true, return a.
3) Step 3: if not, return b.

A. Multi-objective optimization problem

B. NSGA-II

1) Non-dominated Sorting:

2) Crowding Distance:

III. Proposed Algorithm

IV. Numerical Experiments

The experiment results are given in Table I.

The convergence curves are given in Figure 1.

TABLE I: Results of NSGA-II and X

problem	NSGA-II	X
f_1	7.8 (6.1)	10.8 (5.4)
f_2	8.9 (7.2)	11.9 (6.5)
f_3	9.0 (8.3)	12.0 (6.6)

TABLE II: Results of NSGA-II and X

problem	NSGA-II		X	
	mean	std	mean	std
f_1	7.8	(6.1)	10.8	(5.4)
f_2	8.9	(7.2)	11.9	(6.5)
f_3	9.0	(8.3)	12.0	(6.6)

V. Conclusion

References

[1] K. Deb, A. Pratap, S. Agarwal, and T. Meyarivan, "A fast and elitist multiobjective genetic algorithm: Nsga-ii," *IEEE Transactions on Evolutionary Computation*, vol. 6, no. 2, pp. 182–197, 2002.

[2] Q. Zhang and H. Li, "Moea/d: A multiobjective evolutionary algorithm based on decomposition," *IEEE Transactions on Evolutionary Computation*, vol. 11, no. 6, pp. 712–731, 2007.

[3] K. Deb and H. Jain, "An evolutionary many-objective optimization algorithm using reference-point-based nondominated sorting approach, part i: Solving problems with box constraints," *IEEE Transactions on Evolutionary Computation*, vol. 18, no. 4, pp. 577–601, 2014.

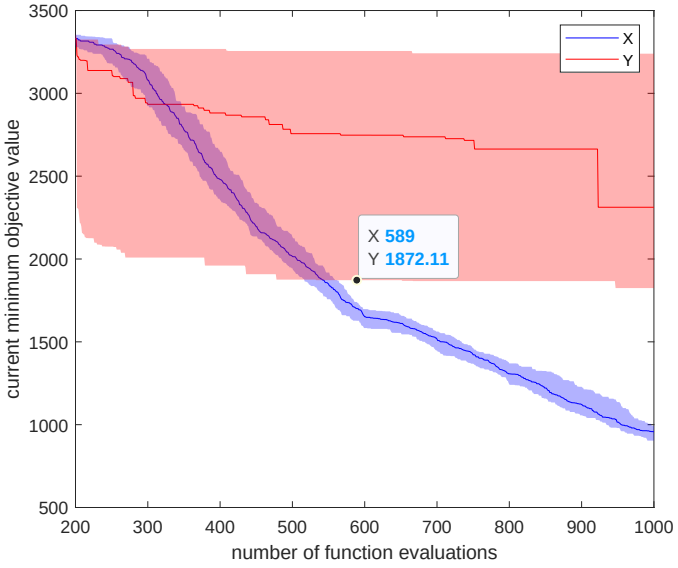
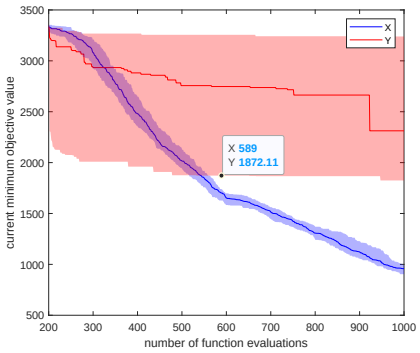
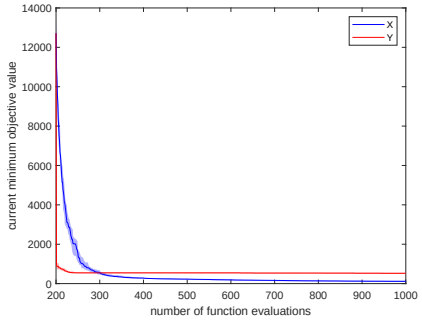


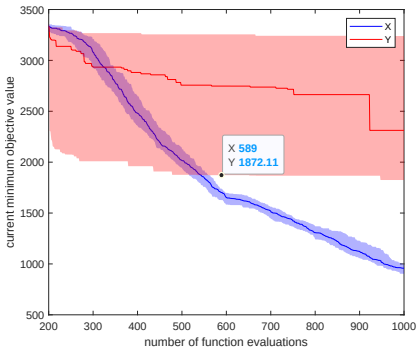
Fig. 1: Convergence curves



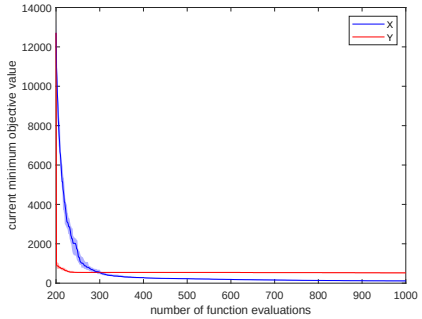
(a) f_1



(b) f_2



(c) f_3



(d) f_4

Fig. 2: Convergence curves