

Autonomous Agent for Multi-objective Optimization

Alain Berro and Stephane Sanchez

IRIT-UT1

Université Toulouse I Sciences Sociales,
1 place Anatole France 31042 Toulouse Cedex, France
{berro, sanchez}@univ-tlse1.fr

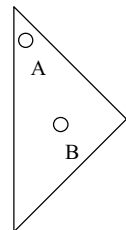
Abstract. In this article, we present an agent-based method associated with a local research inspired by strategies of evolution to solve multiobjective problems. In comparison with GA-based methods this method uses few parameters. Moreover a decision maker can easily understand the influence of these parameters on the result. The conception of this method led us to represent the Pareto optimal set with zones and not with points. This representation gives additional information which allows to choose between two non-dominated solutions.

1 Discussion

The implementation of the multiobjective optimization methods [2,3,4] requires in priority to control the process of a genetic algorithm and to understand the interaction of its various parameters. The relation between the value of a parameter and its action on the resolution of problem is thus very difficult to control without a perfect knowledge of used method. Moreover, much of these parameters have few meaning for a decision maker.

In the method that we carried out, we endeavoured to reduce these difficulties and to preserve qualities of convergence and maintain of diversity. We developed a method having a simple and understandable parameter setting for a non-initiated.

The majority of the methods describe the Pareto-optimal set by a whole of non-dominated points. But they do not provide any additional information which would allow the decision maker to choose a solution compared to another. For example, the figure on the right supposes that the triangle represents the theoretical Pareto-optimal set. This one will not be able to choose between the points *A* and *B* because they are both non-dominated. However we can note on the diagram that the point *B* is preferable at point *A* because *B* is very close to the limit of the optimal zone. By choosing the point *B*, the decision maker will have a safety margin larger than if he selects the point *A*.



Our method allows to evaluate the smallest distance between a Pareto-optimal solution and the limit of the Pareto-optimal set. This characteristic comes from the fact that our process of optimization does not seek Pareto-optimal points but Pareto-optimal zones.

2 Our Research Method

Initially our method was carried out to seek the optima of a function in a dynamic environment [1] and has following characteristics :

- a self-adaptation of number of necessary agents to perform the research,
- only two parameters of adjustment are used,
- an evaluation of margin of error on the position of optimum.

We thus adapted this method for multiobjective optimization problems by using the concept of Pareto's optimum to compare various solutions and to lead agents towards the Pareto-optimal set. Our agent-based method uses a local research inspired of the strategies of evolution. The aim of an agent is to find a Pareto-optimal zone then to increase it. The original contributions of this method are the introduction to the concept of zone of influence and use of an accuracy factor as stop criterion of algorithm. During the design of this method, we also endeavoured to reduce the number of control parameters and to make these parameters understandable for decision makers.

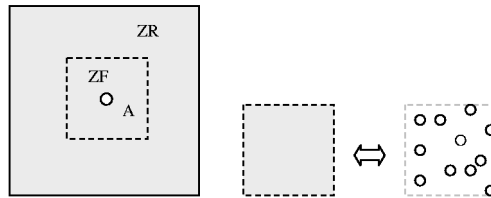


Fig. 1. On the left, the white circle represents the agent position A. The zone of influence ZF of an agent is an area around its position in which all solutions are non-dominated. The search zone ZR of an agent is a area with variable size in which the agent seeks non-dominated solutions. On the right, the zone of influence corresponds to a cluster of solutions.

References

1. Berro, A., Duthen, Y.: Search for optimum in dynamic environment : a efficient agent-based method. GECCO'2001 Workshop on Evolutionary Algorithms for Dynamic Optimization Problems, San Francisco, California, (2001) 51-54
2. Coello, C., A., C., Toscano, G., T.: Multiobjective Optimization using a Micro-genetic Algorithm. In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO'2001), San Francisco, California (2001) 274-282
3. Corne D., W., and al.: PESA II : Region-based Selection in Evolutionary Multiobjective Optimization. In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO'2001), San Francisco, California (2001) 283-290
4. Deb, K.: A Fast Elitist Non-Dominated Sorting Genetic Algorithm for Multiobjective Optimization : NSGA II. Parallel problem Solving form Nature – PPSN VI, Springer Lecture Notes in Computer Science (2000) 849-858