Comprehensive Comparison of Performance of Elite-induced Evolutionary Algorithm for Multi-objective Analysis

Yoshiaki Shimizu*, Ryota Nakamura†

*Toyohashi University of Technology
1-1, Hibarigaoka, Tenpaku-cho, Toyohashi, 441-8580 JAPAN
shimizu@me.tut.ac.jp, http://ise.me.tut.ac.jp

†Toyohashi University of Technology
1-1, Hibarigaoka, Tenpaku-cho, Toyohashi, 441-8580 JAPAN
nakamura@ise.me.tut.ac.jp, http://ise.me.tut.ac.jp

ABSTRACT

To cope with manifold and complicated decision making in modern society, multi-objective optimization (MOP) has gained greater concerns recently. In fact, it is viewed as a promising aid for decision making in global and competitive society from comprehensive point of view. As a family of such MOP studies, we engaged in multi-objective analysis (MOA) and proposed a new idea termed elite-induced evolutionary algorithm (EIEA) [1]. Here, we define MOP as a subjective synthesis to obtain a unique preferentially optimal solution or best compromise solution of decision maker (DM). Meanwhile MOA is viewed as an objective analysis to reveal a trade-off relation among the conflicting objectives or draw a Pareto front in an appropriate manner. Eventually, it can provide DM some useful information to accomplish MOP as a final goal of this decision making.

The proposed EIEA for MOA (EIEA/MOA) is a hybrid method comprised of a conventional mathematical programming method and a recent one referring to multi-objective evolutionary algorithm (MOEA) [2]. In this approach, the former refers to someone of the objective unifying techniques of MOP such as ε-constrained method, weighting method, weighted minmax method, etc. and is used to obtain a few elite solutions that will be involved in a set of the initial solutions of the latter algorithm. Through this simple but complemented combination, EIEA/MOA is able not only to derive the precise Pareto front efficiently but also to conveniently control distribution of the Pareto front following preference of DM. That provides a useful procedure for supporting decision making according to the intension of DM and is also available for a post-optimal analysis of MOP.

In the previous study, we showed these favourable features only for PSA (Pareto Simulated Annealing) of MOEA. To ascertain such properties in advance, this paper tries to evaluate its effectiveness with a comprehensive point of view. Actually, besides PSA, we have deployed the idea over several MOEA methods popularly applied to various problem-solving, i.e. MOPSO, MODE, NSGA II and SPEA II. For pursuing the aim, we provided a few indices to quantitatively and commonly evaluate the performance among these different methods.

To examine the total performances in comparison, numerical experiments have been carried out based on a simple test problem at first. Then, we have turned our attention to the constrained optimization problems as a more practically important and hotter topic in engineering. Finally we will discuss on the effectiveness of the proposed approach through revealing some properties of EIEA/MOA.

REFERENCES

[1] Y. Shimizu, M. Takayama and H. Ohishi, ”Multi-objective Analysis through Elite-induced Evolutionary Algorithm – In the case of PSA”, *Transaction of the Japanese Society for Evolutionary Computation*, **3**, 22-30 (2012) *in Japanese*

[2] Y. Shimizu, Z. Zhang and R. Batres, *Frontiers in Computing Technologies for Manufacturing Applications*, Springer, Chap. 3, 2007.