Multi-Objective Bayesian Optimization Algorithm

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Recently, significant development in the theory and design of competent genetic algorithms (GAs) has been achieved. By competent GA we mean genetic algorithms that can solve boundedly difficult problems quickly, accurately, and reliably. However, most of the existing competent GAs focus only on single-objective optimization although many real-world problems contain more than one objective. Independently of the development of competent genetic algorithms, a number of approaches to solve such multiobjective problems have been proposed. However, there has been little or no effort to develop competent multiobjective operators that efficiently identify, propagate, and combine important partial solutions of the problem at hand.

This study makes an effort towards multiobjective competency by combining the best of both the worlds. Specifically, the study combines competent GAs with advanced techniques for finding and maintaining a diverse set of nondominated solutions defining the Pareto front. In particular, we combine the Bayesian optimization algorithm (BOA) (Pelikan, Goldberg, & Cantú-Paz, 1999) with the nondominated sorting GA (NSGA-II) (Deb, Pratap, & Meyarivan, 2000). The resulting multi-objective Bayesian optimization algorithm (mBOA) incorporates the selection method of the NSGA-II into BOA.

The mBOA methodology can be described as follows: (1) Randomly generate n solutions and perform selection, (2) Build a probabilistic model (Bayesian network) of the promising solutions, (3) Sample new solutions using the Bayesian network, (4) Combine both the parent and the offspring population (5) Perform a non-dominated sorting and compute the crowding distance of the combined population. (6) Select the n *best* (based on the rank and crowding distance) solutions, and (7) Go to step (2) and repeat the process till some convergence criteria are satisfied. Further details on the proposed algorithm are given elsewhere (Khan, Goldberg, & Pelikan, 2002).

The proposed algorithm has been tested on an array of test functions which incorporate deception and loose-linkage and the results are compared to those of NSGA-II. Results indicate that mBOA outperforms NSGA-II on large loosely linked deceptive problems. A representative result on multiple interleaved trap-5 functions is shown in figure 1. It is clear from the figure that the mBOA converges to the actual front and maintains a good spread on it.

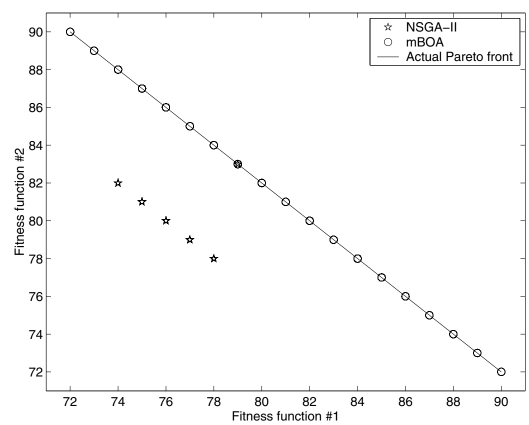

Figure 1: mBOA's performance on multiple interleaved trap-5 deceptive functions (Maximized)

References

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