Evolutionary Multiobjective Optimization and Uncertainty
(Abstract of Invited Talk)

Jürgen Branke

Warwick Business School, University of Warwick, Coventry, UK
juergen.branke@wbs.ac.uk

Abstract. This talk will look at various aspects of uncertainty and how they can be addressed by evolutionary multiobjective optimization.

If there is uncertainty about the user preferences, evolutionary multiobjective optimization is traditionally used to generate a representative set of Pareto-optimal solutions that caters for all potential user preferences. However, it is also possible to take into account a distribution over possible utility functions to obtain a distribution of Pareto optimal solutions that better reflects the decision maker's likely preferences. And furthermore, it may be possible to elicit and learn the decision maker's preferences by interacting with the decision maker during the optimization process.

If there is a trade-off between a solution's quality and associated risk or reliability, evolutionary multiobjective optimization can simply regard the problem as a two-objective problem and provide a set of alternatives with different quality/risk trade-offs.

If the objective functions of the multi-objective problem are noisy and an accurate evaluation is not possible, for example because the evaluation is done by means of a stochastic simulation, it is no longer possible to decide with certainty whether one solution dominates another. One might calculate the probability of one solution dominating the other, and use this for selection. Still, this is based on noisy observations, and does not allow to make a confident decision about which solutions to keep in an elitist algorithm, because the solution observed as better may only have been lucky in the evaluation process. In order to improve the accuracy of the fitness estimates, it is usually possible to average fitness values over a number of evaluations. However, this is time consuming, and so it raises the question how often each solution should be evaluated such that the algorithm can progress, but at the same time computational effort is minimized. Finally, if the goal is to optimize a quantile or even the worst case, it is not obvious how to even define such a concept in a multi-objective setting.

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