Solving multiobjective optimization problems with parameter uncertainty with an interactive method

Yue Zhou-Kangas

April 25, 2017

For multiobjective optimization problems, there is a set of mathematically equally good Pareto optimal solutions and they are not comparable without additional information. Usually, the preferences of a decision maker are utilized to compare Pareto optimal solutions and find the most preferred one for the needs of the decision maker. Multiobjective optimization methods can be classified according to the role of the decision maker in the solution process. The class of interactive methods can best support the decision maker to find the most preferred solution by allowing her/him to iteratively specify her/his preferences and learn about attainable solutions as well as the feasibility of one's preferences until the most preferred solution is found.

Even though conventional interactive methods consider only deterministic multiobjective optimization problems, many practical problems involve uncertainty which can originate from various sources. The uncertainties can render the solutions to unexpected and undesired degradations on their quality (i.e., the objective function values). Thus, a sufficient immunity to the uncertainties which can be called robustness of the solutions should be considered and presented to the decision maker as well during the interactive solution process. As a final result, the decision maker should find a final solution with satisfactory quality and robustness. As said, not much attention has been paid in the literature to supporting the decision maker in terms of solving uncertain multiobjective optimization problems.

In this research, we concentrate on supporting the decision maker to find a most preferred robust solution. We first discuss the major challenges in the interactive solution process of uncertain multiobjective optimization problems. Then we present a variant of the synchronous NIMBUS method, with in which, we utilize the concept of set-based minmax robustness to compute robust Pareto optimal solutions. To help the decision maker to make an informed choice of the solution, we visualize the solutions during the interactive solution process. As with all interactive methods, the visualization of the information exchanged plays an important role. The need is even more obvious here when the decision maker must understand different types of information. We demonstrate this robust variant of synchronous NIMBUS with an example problem.