Applied Mathematics

Supporting Decision Making with Interactive Multiobjective Optimization Methods: NAUTILUS Family

Kaisa Miettinen
University of Jyvaskyla, Department of Mathematical Information Technology, Finland

Multiobjective optimization problems involve several conflicting objective functions to be optimized simultaneously. Solutions are called Pareto optimal if no objective function can be improved without impairing any of the others. As there typically exist many Pareto optimal solutions and vectors cannot be ordered completely, some additional information is needed from a decision maker to identify the most preferred solution to be implemented.

Many different multiobjective optimization methods have been proposed over the years and in them a decision maker iteratively directs the solution process with one's preference information. Most methods deal with Pareto optimal solutions only which means that the decision maker must be willing to trade-off, that is, sacrifice in some objective function values in order to get improvement in some others. Because people do not react symmetrically to gains and losses and because one can easily anchor around the starting solution, the most preferred solution may not be found.

A family of NAUTILUS methods is introduced where the decision maker does not need to trade-off but (s)he can direct the solution process more freely. The decision maker iteratively approaches the set of Pareto optimal solutions and only the final solution is Pareto optimal. The decision maker can provide preference information as a direction of simultaneous improvement or by choosing from a small set of alternatives. The so-called E-NAUTILUS method is tailored for computationally expensive problems where function evaluations are time-consuming (e.g. because of computationally expensive simulations). In such cases, it is important that the decision maker does not need to wait for new solutions to be generated. Finally, a NAUTILUS framework is briefly introduced which collects members of the NAUTILUS family.