Master's Thesis

A New Sequential Quadratic Programming Method for Constrained Multiobjective Optimization Problems

Guidance

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Abstract

In multiobjective optimization, multiple objective functions have to be minimized simultaneously. Applications of this type of problem can be found in many fields, such as engineering, finance and management science. Recently, many researchers have developed the so-called descent methods for multiobjective optimization problems, which are extensions of traditional methods for single-objective problems to the vector-valued case. Differently from heuristics and scalarization approaches, they have theoretical guarantee of convergence, and they also do not require unknown parameters in advance. However, the research about descent methods for constrained multiobjective optimization is still recent. Here, we focus on the sequential quadratic programming (SQP) method, which is a method known for its efficiency in single-objective nonlinear optimization.

In this work, we consider a new SQP method for constrained multiobjective optimization problems.The method is iterative, and at each iteration, a subproblem is solved to obtain the search direction, and a step size is chosen based on line searches. The subproblem uses quadratic approximations of the objective functions and linear approximations of the constraints. Concerning the quadratic approximation of the objective functions, we also replace the objectives' Hessian matrices for an approximated matrix, in order to make the subproblem even easier to solve. We then compare to the SQP-type method proposed by Ansary and Panda (2019), which is, as far as we know, the unique existing work related to SQP approach for and multiobjective problems. We note that their subproblem considers quadratic approximations also for the constraint functions, which makes the problem more complex. Their method also requires convexity, which is not assumed in our case. For globalization, we also use the vector-valued ℓ_1 penalty function as a merit function. The step size is determined by imposing the Armijo condition for this function, and we update the approximated matrices using a modified BFGS formula. Moreover, we show that any accumulation point of a sequence generated by the algorithm is a critical point in the Pareto sense, under some assumptions. Finally, we confirm the effectiveness of our algorithm with some numerical experiments.