Master's Thesis

A globally convergent descent method for robust multi-objective optimization problems with implementation errors

Guidance

Associate Professor Ellen Hidemi FUKUDA
Assistant Professor Yuya YAMAKAWA

Yuki KAWABATA

Applied Mathematics and Physics Course
Department of Informatics
Graduate School of Informatics
Kyoto University

February 2025

Abstract

Problems that minimize or maximize multiple objective functions are called multi-objective optimization problems. This work addresses robust multi-objective optimization problems by considering implementation errors in the decision variables. We define the uncertainty set as a ball and assume that the implementation errors lie within this set. Furthermore, we define a robust multi-objective optimization problem where the uncertainty set varies depending on the objective functions.

A descent method is an iterative algorithm that updates the solution using the descent directions and stepsizes. First, we define the descent direction and the robust Pareto optimality. Then, we describe the subproblems for finding the descent direction. With these, we propose the overall method for the robust multi-objective optimization problems with implementation errors. Moreover, we prove the global convergence of the proposed method under the condition that all objective functions are convex. Additionally, numerical experiments were conducted by considering a specific algorithm for solving the subproblems and a line search technique for determining the stepsizes. Through the numerical experiments, we confirmed that the Pareto frontier can be obtained efficiently for a reasonable number of problems.