Abstract

Uncertainty pervades our everyday lives. As a result, the data of real-world optimization problems is attacked by uncertainty. Many real-life optimization problems can be formulated as uncertain multi-objective and set-valued optimization problems. Robust optimization is a prominent approach for solving optimization problems that takes into account uncertainty and variability in the problem data. The aim of the thesis is to study uncertain multi-objective and set-valued optimization problems through the robust optimization approach in topological vector spaces. The introductory segment of the thesis is affiliated at the beginning. It concisely introduces and delivers an adequate literature survey on robust optimization and uncertain multi-objective and set-valued optimization problems. The thesis is devoted to the study of uncertain multi-objective optimization problems by first studying an uncertain real-life multi-objective optimization problem, like an uncertain multi-objective Chinese Postman problem, through the robust optimization approach. Next, the existence criteria of robust solutions for uncertain generalized multi-objective optimization problems (UGMOPs) are proposed through the FAN-KKM, Cantor's intersection theorems, and a generalized signed distance function. The optimality conditions of the robust solutions of UGMOPs is established. Also, a relationship between the robust solutions of UGMOPs and a family of vector optimization problems is presented. Two regular weak separation functions are introduced for obtaining the optimality conditions. Furthermore, the arcwise connectedness of the robust solutions of UGMOPs has been studied. Moreover, several examples and real-life applications of the results obtained for UGMOPs are presented. Apart from this, we have studied uncertain set-valued optimization problems (USOPs), which is a more generalized version of uncertain scalar and multi-objective problems in some sense. By using the generalized Gerstewitz and signed distance functions, specific isolated sets are defined for different notions of robust solutions. Then, the optimality conditions of robust solutions for USOPs are cataloged by making use of image space analysis and those sets. Moreover, several examples and real-life applications of the results obtained for USOPs are presented.

Keywords: Uncertain multi-objective optimization problems; Uncertain set-valued optimization problems; Uncertain chinese postman problem; Robustness; Image space analysis.