A Newton-type method for multiobjective optimization problems

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Abstract

In this paper, we propose a Newton-type algorithm for nonconvex multiobjective optimization problems. The presented terminates, when the termination conditions are satisfied. Convergence of the algorithm is considered.

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1 Introduction

In multiobjective optimization, several conflicting objectives have to be minimized, simultaneously. Generally, no unique solution exists but a set of mathematically equally good solutions can be identified, by using the concept of Pareto optimality. For solving large scale nonlinear multiobjective optimization problem, iterative methods are very effective. Recently, some iterative approaches for solving multiobjective optimization problems were developed [1, 4]. Newton's method for single objective optimization problems was extended to multiobjective optimization problems by Fliege et al. [1], which uses convexity assumption. Now in this paper, we present a Newton-type algorithm that works for nonconvex functions also under suitable assumptions, denote its global convergence. The necessary assumption is that the objective functions are twice continuously differentiable but no other parameters or ordering of the functions are needed.

2 Basic Definitions

In this paper, we consider the following unconstrained nonconvex multiobjective optimization problem

$$\begin{aligned} \min \quad & F(x) = (F_1(x), \ldots, F_m(x)) \\ s.t. \quad & x \in U \subset \mathbb{R}^n \end{aligned}$$

where $F = (F_1, \ldots, F_m)^T : U \to R^m$ is continuous differentiable and $U \subset \mathbb{R}^n$ is the domain of F which is assumed to be open. Let $I = \{1, 2, \ldots, m\}$, for any $u, v \in \mathbb{R}^m$, we define

$$u \leq v \Longleftrightarrow v - u \in \mathbb{R}^m_+ \Longleftrightarrow v_j - u_j \geq 0, j \in I,$$

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