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Second Order Optimality Conditions in Nonsmooth Analysis on Riemannian Manifolds

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Abstract : Much attention has been paid over centuries to understanding and solving the problem of minimization of functions. Compared to linear programming and nonlinear unconstrained optimization problems, nonlinear constrained optimization problems are much more difficult. Since the procedure of finding an optimizer is a search based on the local information of the constraints and the objective function, it is very important to develop techniques using geometric properties of the constraints and the objective function. In fact, differential geometry provides a powerful tool to characterize and analyze these geometric properties. Thus, there is clearly a link between the techniques of optimization on manifolds and standard constrained optimization approaches. Furthermore, there are manifolds that are not defined as constrained sets in R^n an important example is the Grassmann manifolds. Hence, to solve optimization problems on these spaces, intrinsic methods are used. In a nondifferentiable problem, the gradient information of the objective function generally cannot be used to determine the direction in which the function is decreasing. Therefore, techniques of nonsmooth analysis are needed to deal with such a problem. As a manifold, in general, does not have a linear structure, the usual techniques, which are often used in nonsmooth analysis on linear spaces, cannot be applied and new techniques need to be developed. This paper presents necessary and sufficient conditions for a strict local minimum of extended real-valued, nonsmooth functions defined on Riemannian manifolds.

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