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Generalized Semi-Infinite Optimization and Related Topics

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Compared with common nonlinear programming problems which are finitely constrained by equalities and inequalities, each problem of our interest exhibits two special defining features. Namely, it may have *an infinite number of inequality contraints*, making the problem semi-infinite, and *the index set of these inequality constraints is allowed to depend on the state* x. Moreover, by assuming that set to be itself a finitely constrained feasible set, we define its structure. This description leads to the following statement of our actual problem:

$$\mathcal{P}(f,h,g,u,v) \qquad \left\{ \begin{array}{l} \text{Minimize} \quad f(x) \quad \text{for} \quad f:\mathbb{R}^n \to \mathbb{R} \\ \text{under the constraining condition} \ \ x \in M[h,g]. \end{array} \right.$$

Here, h, g denote the equalities and inequalities, respectively, and $u(x,\cdot)$, $v(x,\cdot)$ implicitly define the sets $Y(x) = M[u(x,\cdot),v(x,\cdot)]$ $(x \in \mathbb{R}^n)$ of those inequalities.

In the course of our main investigations on structurally easier problem representations, optimality conditions and iteration procedures, we shall assume that the defining functions f, h, g, u, v are continuously differentiable. The set of these data is endowed with the Whitney topology C^1_S. If, however, we do also consider aspects on structural stability of our entire global problem, then we suppose a higher order of differentiability and, hence, we refer to some Whitney topology C^k_S $(k \in \mathbb{N},\ k \geq 2)$.

This work consists of four chapters and a small appendix, which is devoted to such topological bases and tools. In the last chapter, we widen our field of interest by means of studying different optimal control problems $\mathcal{P}^{\mathsf{tm}}$ or $\mathcal{P}(\ell, L, F, H, G)$. Here, some weakening of our differentiability assumptions in the form of a piecewise (C^k-) concept $(k \in \mathbb{N} \cup \{0\})$ leads to new insights.