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OPTIMAL INNER STEP ACCURACY CONTROL IN BI-LEVEL ITERATION PROCESSES

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Abstract. *In this paper, we give a new methodology of the optimal control of the upper and lower level accuracy based upon a solution of an infinite-dimensional optimization problem. We state the problem, solve the optimum accuracy control problem and develop a simple scheme to calculate quasi-optimal lower level tolerance parameters. These practical formulas are based upon the theoretical examination of the related computational cost minimization problems in an infinite-dimensional space of parametric sequences.*
Keywords: Bi-level iteration process, Lower level precision optimal control, Infinite-dimensional optimization problem

1. **Introduction.** Many numerical algorithms solving optimization problems of various kinds are finally reduced to iteration processes of the form:

$$x_{m+1} = \Phi(x_m), \quad m = 0, 1, \ldots, \tag{1}$$

where $\Phi : R^p \to R^p$ is a finite-dimensional mapping. It is quite common that to find the next iteration $x_m \in R^p$ one has to apply a lower level iteration procedure of a general form:

$$\begin{cases} z_s = \Psi(z_{s-1}, x_m), \quad s = 1, 2, \ldots, \\ z_0 = x_m. \end{cases} \tag{2}$$

Usually, procedure (2), in its turn, requires infinite number of iterations, i.e.,

$$x_{m+1} = \lim_{s\to\infty} z_s. \tag{3}$$

Therefore, at each step m of the upper level iteration process (1), one is to decide when to stop the lower level iteration procedure (2). This problem is very important for the practical needs, as its optimal (or even "quasi"-optimal) solution allows one to save greatly on the computational cost of the global process (1) by cutting off redundant calculations at the lower level (2).