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A TWO-PHASE STRATEGY FOR EFFECTIVE PARAMETER ESTIMATION

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A central problem in mathematical modeling is the task of optimizing an objective function $f : \mathbb{R}^n \to \mathbb{R}$, defined in terms of a set of parameters $\mathbf{x} \in \mathbb{R}^n$. In general, when f is analytically or numerically differentiable, derivative-based algorithms can be applied to obtain its optimal value. Derivative-based optimization algorithms still run the risk of being trapped in local minima/maxima even when derivatives of f can be calculated to machine precision.

This paper proposes a two-phase solution to the optimization problem in which the first phase involves an approximate global search to identify multiple feasible regions in the parameter space. The global search uses an intelligent Monte-Carlo algorithm. The second phase uses gradient information to perform local search in the regions identified in the first phase.

It is demonstrated that this hybrid algorithm provides an effective computational framework for parameter estimation, especially for cases involving multi-modal objective functions, which are not necessarily convex in the whole parameter space. Examples are presented using a selected number of benchmark optimization functions with $n \leq 10$, and a biological model using empirical data.