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Bayesian Multi-objective Optimization with Noisy Evaluations using the Knowledge Gradient

Bruno Barracosa^{1,2} Julien Bect² H elo ise Baraffe¹
Juliette Morin¹ Gilles Malarange¹ Emmanuel Vazquez²

¹EDF R&D, France, bruno.tebbal-barracosa@edf.fr
heloise.baraffe@edf.fr, juliette.morin@edf.fr, gilles.malarange@edf.fr

²Laboratoire des Signaux et Syst emes (L2S)
CentraleSup elec, CNRS, Univ. Paris-Sud, Universit  Paris-Saclay, France,
julien.bect@centralesupelec.fr, emmanuel.vazquez@centralesupelec.fr

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We consider the problem of multi-objective optimization in the case where each objective is a stochastic black box that provides noisy evaluation results. More precisely, let f_1, \dots, f_q be q real-valued objective functions defined on a search domain $\mathbb{X} \subset \mathbb{R}^d$, and assume that, for each $x \in \mathbb{X}$, we can observe a noisy version of the objectives: $Z_1 = f_1(x) + \varepsilon_1, \dots, Z_q = f_q(x) + \varepsilon_q$, where the ε_i s are zero-mean random variables. Our objective is to estimate the Pareto-optimal solutions of the problem:

$$\min f_1, \dots, f_q. \tag{1}$$

We adopt a Bayesian optimization approach, which is a classical approach when the affordable number of evaluations is severely limited—see, e.g., [1], in the context of multi-objective optimization. In essence, Bayesian optimization consists in choosing a probabilistic model for the outputs Z_i and defining a sampling criterion to select evaluation points in the search domain \mathbb{X} .

Here, we propose to discuss the extension of the Knowledge Gradient approach [2] for solving the multi-objective problem (1). For instance, such an extension has been recently proposed by Astudillo and Frazier [3].

References

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