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► **To cite this version:**

Bruno Barracosa, Julien Bect, H elo ise Baraffe, Juliette Morin, Gilles Malarange, et al.. Bayesian multi-objective optimization with noisy evaluations using the Knowledge Gradient. PGMO Days 2019, Dec 2019, Palaiseau, France. hal-02475345

HAL Id: hal-02475345

<https://centralesupelec.hal.science/hal-02475345v1>

Submitted on 11 Feb 2020

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

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Keywords: Bayesian optimization, global optimization, multi-objective optimization, noisy optimization, simulation optimization

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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