Bayesian multi-objective optimization with noisy evaluations using the Knowledge Gradient
Bruno Barracosa, Julien Bect, Héloïse Baraffe, Juliette Morin, Gilles Malarange, Emmanuel Vazquez

To cite this version:
Bruno Barracosa, Julien Bect, Héloïse 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-02475345
Submitted on 11 Feb 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Bayesian Multi-objective Optimization with Noisy Evaluations using the Knowledge Gradient

Bruno Barracosa\textsuperscript{1,2}, Julien Bect\textsuperscript{2} Hélöïse Baraffe\textsuperscript{1}
Juliette Morin\textsuperscript{1} Gilles Malarange\textsuperscript{1} Emmanuel Vazquez\textsuperscript{2}

\textsuperscript{1}EDF R&D, France, bruno.tebbal-barracosa@edf.fr
heloise.baraffe@edf.fr, juliette.morin@edf.fr, gilles.malarange@edf.fr
\textsuperscript{2}Laboratoire des Signaux et Systèmes (L2S)
CentraleSupélec, CNRS, Univ. Paris-Sud, Université Paris-Saclay, France,
julien.bect@centralesupelec.fr, emmanuel.vazquez@centralesupelec.fr

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 \( f_1, \ldots, f_q \) be \( q \) real-valued objective functions defined on a search domain \( X \subset \mathbb{R}^d \), and assume that, for each \( x \in X \), we can observe a noisy version of the objectives: \( Z_1 = f_1(x) + \varepsilon_1, \ldots, Z_q = f_q(x) + \varepsilon_q \), where the \( \varepsilon_i \)'s are zero-mean random variables. Our objective is to estimate the Pareto-optimal solutions of the problem:

\[
\min f_1, \ldots, f_q.
\]  

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 \( X \).

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

