Baysian Optimization in MPC

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Abstract

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I. Introduction

We start by introducing bayesian optimization and MPC on a high level. This is done to let you know what I understand when talking about these algorithms.

i. What is Bayesian Optimization?

Bayesian optimization is a strategy for global optimization of backbox functions. It therefore does not require the computation of gradients, but works best on continuous functions. It is best suited for optimizing functions, where each evaluation takes a long time. The number of input dimensions for bayesian optimization is typically less then 20.[1]

ii. What is MPC?

MPC is an acronym for model predicive control. It replaces classical control algorithms that usually work in an offline manner with an optimizer, that solves the optimal control problem for a receding horizon (Figure 1). Each action taken is the first action of the optimal control plan. The plan gets updated continuously (Figure 2).

Algorithm 1 Bayesian Optimization

```
f ← black box function
initPos ← initial positions
evaluations ← f(initPos)
α ← calcAquisitionFunction(evaluations)
for i = 1 → N do
    nextPos ← argmax(α)
    evaluations.append(f(nextPos))
    α ← calcAquisitionFunction(evaluations)
result ← max(evaluations)
```

II. Methods

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Figure 1: *Blockdiagram of MPC algorithm*

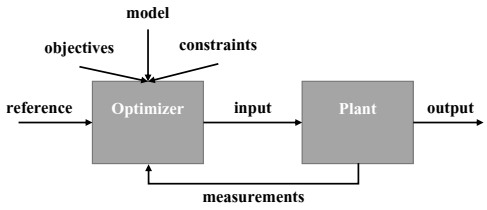
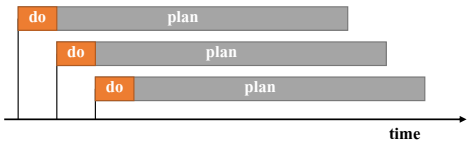


Figure 2: *Plan horizon of MPC algorithm*



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Text requiring further explanation[1].

Table 1: *Example table*

Name		
First name	Last Name	Grade
John	Doe	7.5
Richard	Miles	2

III. Results

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$$e = mc^2 \tag{1}$$

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[1] Example footnote

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IV. Discussion

i. Subsection One

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ii. Subsection Two

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[1] Peter I Frazier. A tutorial on bayesian optimization. *arXiv preprint arXiv:1807.02811*, 2018.

[2] Farshud Sorourifar, Georgios Makrygirgos, Ali Mesbah, and Joel A Paulson. A data-driven automatic tuning method for mpc under uncertainty using constrained bayesian optimization. *IFAC-PapersOnLine*, 54(3):243–250, 2021.