

# Research internship in uncertainty quantification: hybrid multifidelity Monte Carlo methods.

Cerfacs, Toulouse.

**Position:** M2 or engineer internship

**Background:** M1 (or equivalent) in computer science or applied mathematics

**Starting date:** March/April 2023

**Duration:** 6 months

**Salary:** 650€ net per month

**Hosting institution:** Cerfacs (Toulouse), <https://cerfacs.fr>

**Contact persons:** Paul Mycek (Cerfacs) and Reda El Amri (IFPEN)

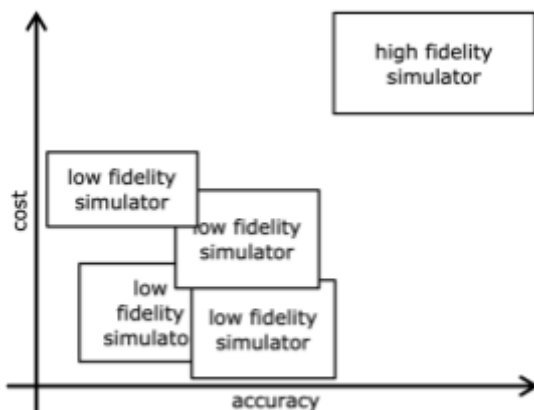
**Keywords:** Uncertainty quantification, multifidelity, Monte Carlo methods, surrogate modeling.

**How to apply:** Send a CV and a cover letter to [mycek@cerfacs.fr](mailto:mycek@cerfacs.fr) and [mohamed-reda.el-amri@ifpen.fr](mailto:mohamed-reda.el-amri@ifpen.fr).

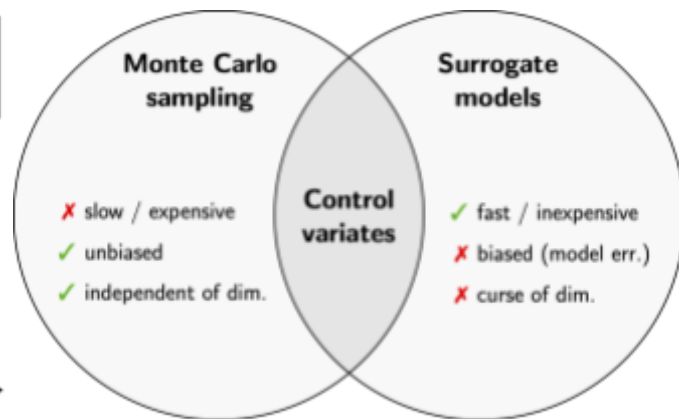
## Description

Multifidelity techniques for statistical estimation constitute an emerging and rising branch of numerical methods for uncertainty quantification [Peherstorfer et al., 2018]. In an industrial context where the numerical simulators are expensive to evaluate (in terms of CPU time), pure Monte Carlo estimation would lead to prohibitively long estimation. On the other hand, in high-dimensional uncertain input spaces, surrogate models constructed from a reasonable (limited) number of training data points typically lead to significantly high model error (bias). Recent approaches based on the variance reduction technique called control variates propose to combine Monte Carlo sampling of the high-fidelity (expensive) numerical simulator with low-fidelity surrogate models, to make the most of both worlds [Yang et al., 2022].

This internship aims to explore alternative formulations of the approach proposed in [Yang et al., 2022].



Adapted from [Peherstorfer et al., 2018]



Adapted from [Yang et al., 2022]

## Required skills

- Experience in python, numpy, scipy
- Elementary knowledge in probability and statistics

## Desired skills

- Experience in uncertainty quantification
- Experience in Monte Carlo simulations and/or surrogate modeling