

Algorithms for Uncertainty Quantification

Tutorial 11: Software for Uncertainty Quantification

In this worksheet, we focus on UQ case studies and UQ software that could be used to approach those case studies.

Software for UQ

In the lecture we saw a list comprising libraries/frameworks/toolkits for UQ; the ones discussed in the lecture are marked in bold.

- **chaospy**
- **Dakota**
- MUQ library
- Mystic
- NASA UQTools
- OpenCossan (matlab)
- **Openturns**
- Π4U
- Promethee
- Psuade
- **Queso**
- SG++
- SmartUQ
- **TASMANIAN**
- UQLab (matlab)
- UQ Toolkit (**UQTK**)
- **Uranie**
- ...

In the following, we discuss a series of five case studies. The purpose is to discuss what methodology/methodologies and which library/framework/toolkit would you use for the propagation of uncertainty?

Case study one

You are given a forward model, for which a single run takes about 10 minutes. You know what phenomena the given code models, but you can use it only as a legacy code, i.e. a black box. Moreover, you know that 8 input parameters are uncertain. What methodology and which library/framework/toolkit from the above list would you use for the propagation of uncertainty? Why?

Case study two

You are given a forward model, for which a single run takes about 30 seconds. You know what phenomena the given code models, but you can use it only as a legacy code. Moreover, you know that 20 of its input parameters are uncertain. What methodology and which library/framework/toolkit from the above list would you use for the propagation of uncertainty? Why?

Case study three

You are given a forward model, for which a single run takes about 2 hours. You know that the uncertainty resides in five input parameters. What methodology and which library/framework/toolkit from the above list would you use for the propagation of uncertainty? Why?

Case study four

You are given a forward model, for which a single run takes about 3 minutes; assume that you have access to the underlying model. You know that the uncertainty resides in a quantity that varies continuously, at every point in the entire domain of the problem. What methodology and which library/framework/toolkit from the above list would you use for the propagation of uncertainty? Why?

Case study five

You are given a mathematical model and a corresponding numerical implementation. One run of the given code takes about five minutes. Furthermore, you know that two input parameters are uncertain. You are required to compute statistics of the output of interest with high accuracy. What methodology and which library/framework/toolkit from the above list would you use for the propagation of uncertainty? Why?