UF Metamodeling & Data assimilation I

INSA Toulouse - 5 ModIA

Resp.: O. Roustant

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UF structure

Gaussian process (GP) and uncertainty quantification (UQ)

- Olivier Roustant (INSA) + Mathis Deronzier (Doc IMT)
- Moodle https://moodle.insa-toulouse.fr/course/view.php?id=1744

Data assimilation : sequential and ensemble-based approaches

- Adaptation of models with real-time observations.
- Serge Gratton (N7) + Ehouarn Simon (N7)

Remarks

- Common point between the two parts: covariance kernels.
- The UF has a second part in the next semester, *Metamodeling & Data assimilation II*, with advanced applications.

Evaluation of the UF

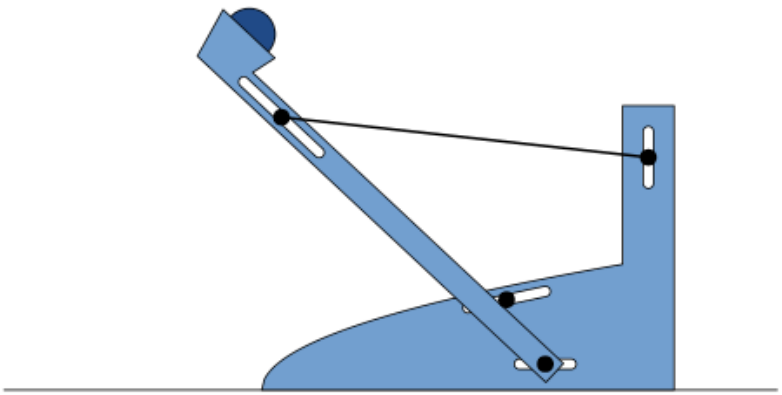
- Exam 1 (October) about GP and UQ (coef 1/3)
- Exam 2 (December) about Data Assimilation (coef 1/3)
- Case studies (coef 1/3)
  - Case study 1 (GP and UQ), written report, 50% of the mark
  - Case study 2 (Data assimilation), oral defense, 50% of the mark

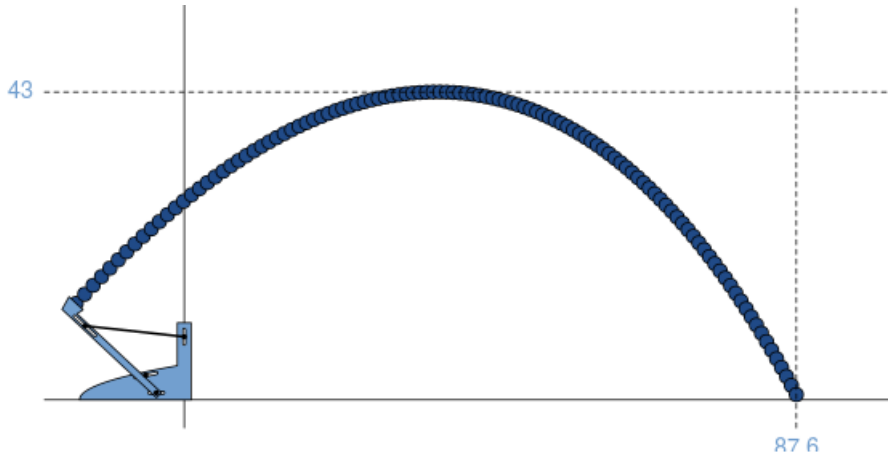
Presentation of the “Metamodeling” part

In metamodeling, we can CREATE DATA (= DESIGN EXPERIMENTS), by doing PHYSICAL or SIMULATED experiments.

The question is: HOW can we do this in order to have ACCURATE MODELS, to OPTIMIZE, to QUANTIFY UNCERTAINTY, ...?

Example: How can we tune the 4 variables of a catapult in order to launch a projectile as far as possible?





In the real life, the catapult can be A PHYSICAL EXPERIMENT, A SIMULATOR, AN ALGORITHM (that we want to tune)...
When the experiment is TIME-CONSUMING, we need to construct a FAST PROXY MODEL or METAMODEL.

UF program

Part I - Metamodeling: GP and UQ

- Gaussian processes
- Covariance kernels and RKHS
- Gaussian process regression
- Design of computer experiments
  - Uniform (”space-filling”) designs
  - Adapative designs, Bayesian optimization
- Global sensitivity analysis
- Case study

Part II - Data Assimilation

To be announced by Serge Gratton and Ehouarn Simon.

Focus on Metamodeling - Evaluation

Individual exam

Similar problems than in class. In particular, you should be able:

- To do computations on Gaussian processes and kernels
- To compute ANOVA decomposition and Sobol indices

Report on the case study

By groups of 3 or 4