

Lecture: Design and analysis of computer experiments

Lab: Implementation and analysis of computer experiments

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Aims

The aim of the lecture and the associated computer lab is to introduce the basic concepts from the area of the design of experiments, which is used to help us understand the behaviour of complex computational models. In particular, we will look at the relations between inputs and outputs of complex models, various types of design (factorial and Latin Hypercube), and the methods of analysis of the results of simulation experiments through response surfaces and meta-models (emulators). Special attention will be paid to the statistical methods of uncertainty and sensitivity analysis, in particular based on Gaussian processes.

Selected reading

The below selection is provided for information only: the participants are not expected to read any materials in advance. Key readings are marked with (*), and the remainder is for further interest.

Books:

(*) Santner TJ, BJ Williams, WI Notz (2003) *The Design and Analysis of Computer Experiments*. New York: Springer.

Fang K-T, R Li, A Sudjianto (2006) *Design and Modeling for Computer Experiments*. London: CRC/Chapman and Hall.

Articles and other materials:

(*) Kleijnen JPC (1995) Verification and validation of simulation models. *European Journal of Operational Research*, 82(1): 145–162. DOI: 10.1016/0377-2217(94)00016-6

(*) MUCM (Managing Uncertainty in Complex Models): website with online resources, methods toolkit and extensive documentation. See: <http://www.muqm.ac.uk>, and <http://muqm.aston.ac.uk>

Bijak J, Hilton J, Silverman E and Cao VD (2013) Reforging the Wedding Ring: Exploring a Semi-Artificial Model of Population for the United Kingdom with Gaussian process emulators.

Demographic Research 29(27): 729–766. <http://www.demographic-research.org/volumes/vol29/27/>

Di Paolo EA, J Noble, S Bullock (2000) Simulation models as opaque thought experiments. In: *ALife 7 conference proceedings*, Cambridge MA: MIT Press, 497–506. <http://eprints.soton.ac.uk/261455>

Kennedy M, O'Hagan A (2001) Bayesian calibration of computer models. *Journal of the Royal Statistical Society B*, 63(3), 425–464. DOI: 10.1111/1467-9868.00294

Plasun R (1999) Optimization of VLSI Semiconductor Devices. PhD thesis, TU Wien.

<http://www.iue.tuwien.ac.at/phd/plasun/diss.html>: Chapter 3.

Silverman E, Hilton J, Noble J and Bijak J (2013) Simulating the cost of social care in an ageing population. In: W Rekdalsbakken, RT Bye and H Zhang (eds.) *Proceedings of the 27th ECMS*, p. 689–695. <http://drericssilverman.files.wordpress.com/2013/06/ecms-silverman.pdf>