Project proposal

Multi-objective optimisation of stochastic simulation models

Background: Often when optimising complex systems, the quality of a solution can only be determined by running a simulation model, for example if one wants to determine the throughput of a factory, the average waiting times for a call centre, travel times in a city, or how well a biological model fits to observation data. To capture the uncertainty present in the real world, these simulation models are usually stochastic. This is a particular challenge for optimisation tools, as evaluating the same solution multiple times based on different random seeds yields different performance values, and so it is not even easy to decide which of two solutions is better. Furthermore, simulations are computationally expensive, so the number of simulation runs that can be performed during optimisation is very limited.

The two supervisors have recently developed a Simulated Annealing algorithm specifically tailored for optimisation of stochastic simulation models, with a provably optimal sampling strategy.

Mini-project: Depending on student interests, the above mentioned Simulated Annealing algorithm could be extended in one of the following two ways:

1. the consideration of simulation runtime (it is often possible to abort a simulation early but still get a reasonable estimate of the solution quality)
2. the handling of multiple objectives, in which case the goal is to identify a set of solutions with different trade-offs.

Deliverable: Working code, paper with some empirical results on artificial benchmark problems (as those are quicker to compute)

PhD prospect: The project would be sponsored by ESTECO, a company in Trieste, Italy (www.esteco.com). ESTECO is producer of a leading simulation optimisation platform in the engineering world (modeFrontier). But most engineering simulations are deterministic. In order to expand their application area, ESTECO would like to enhance their tool to also be able to handle stochastic simulation models. The goal of the PhD project would therefore be to develop and implement an efficient optimisation algorithm for stochastic simulation models. Besides the above mentioned aspects of considering simulation time and working with multiple objectives, the algorithm should also be able to quantify the uncertainty in the performance estimates to support a decision maker in selecting the most preferred solution.

Student requirements: Programming skills, willingness to spend some time in Italy (travel expenses would be covered)