Project proposal

Bayesian Optimisation with Travelling Cost

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Background: Bayesian Optimisation [1] has become a very hot topic for complex global optimisation problems which are expensive to evaluate, such as in engineering, where evaluating a solution involves running a time-consuming simulation, or in machine learning, where evaluating a neural network architecture involves training it first.

Bayesian Optimisation starts by evaluating a few solutions, then builds a surrogate model (response surface) of the problem. This surrogate model is then used to determine which additional solution, if evaluated, would yield the largest expected value of information.

However, there are some optimisation problems where evaluating a solution involves moving some equipment to the location to be evaluated, e.g. when drilling for oil or measuring air quality. If the cost of transportation is not negligible, it should be taken into account when deciding which solution to evaluate next. Designing a Bayesian Optimisation algorithm for this type of problem is the goal of this project.

Mini-project: There are some simple strategies that can be tried during the mini-project, e.g., restricting the step size from one solution to the next, or simply substracting the cost of moving to a sample location from the value of the sample location.

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

PhD prospect: The strategies of the mini-project would be very simple and myopic, to establish a baseline and get some initial results quickly. In the PhD project, the goal would be to develop some strategies that take into account the time-dependence of decisions, e.g., that moving into a certain direction influences the cost to move to other places in the future.

Student requirements: Programming skills.

References:

[1] B. Shahriari, K. Swersky, Z. Wang, R. P. Adams and N. de Freitas, "Taking the Human Out of the Loop: A Review of Bayesian Optimization," in *Proceedings of the IEEE*, vol. 104, no. 1, pp. 148-175, 2016
[2] J. Jocque, T. V. Seenkiste, P. Stoobant, R. Delanghe, D. Deschrijver, T. Dhaene, “Learning to forget: design of experiments for line-based Bayesian Optimization in Dynamic Environments”. Winter Simulation Conference, 2019