Complexity Science mini-project:
Efficient Global Optimization for Dynamically Changing Problems

Background: Many complex optimisation problems are changing over time. Performing well in such environments requires to continuously track the optimal solution. Because of time constraints, it is generally not possible to simply search for the best solution from scratch whenever the problem has changed. Instead, it is important to re-use information learned in the past. Efficient Global Optimization (EGO) [1], which is based on Gaussian Process Networks and statistical techniques, is a powerful optimisation heuristic for stationary problems.

Mini-project: The goal of the mini-project would be to extend the EGO algorithm to be able to work well in dynamically changing problems. This should be relatively straightforward as Gaussian Process Networks allow taking into account the certainty of information, and in a dynamic environment, older information could simply be regarded as less certain.

PhD prospect: There are many practical problems that change over time. For optimization problems where the current decisions influence the future problem state (e.g., if deciding to service a particular customer means that in the future, the worker will be at that customer's location), future states need to be anticipated. So, developing the above approach into an anticipatory optimization approach is an interesting challenge. Furthermore, the PhD could expand on a practical application. For example, we plan to collaborate with SAP to work on dynamic vehicle routing problems.

Deliverables:

A variant of EGO that can be applied to dynamically changing optimisation problems.

Student's requirements:

Experience with Matlab and/or Gaussian Process Networks would be beneficial. One of my PhD students is working with Gaussian Processes, so competent help is available.

References

[1] Jones, Schonlau, Welch: Efficient global optimization of expensive black-box function. Journal of Global Optimization 13(4), pp. 455-492, 1998