



Engineering Optimisation with Bayesian Optimisation and OpenFOAM

Prof Gavin Tabor, Dr Steven Daniels, Prof Jonathan Fieldsend

*University of Exeter
Department of Engineering
Harrison Building, North Park Road
Exeter, EX4 4QF, UK,
+44 1392 723662
g.r.tabor@ex.ac.uk & Academic*

Computational Fluid Dynamics is an important component of engineering simulation and design. The high costs of simulation have previously restricted its use to testing a small number of possible designs; however, improvements in computing power now make it possible to perform the multiple runs necessary to automatically optimise real engineering systems. However, automated optimisation algorithms still have to be carefully designed to minimise the number of individual simulations performed. Bayesian Optimisation is a technique from Machine Learning in which the emphasis is on the process of learning an objective function which is an approximation to the cost function for the design; once an initial objective function has been learnt the process of finding the optimum solution(s) is relatively straightforward, and the objective function may be incrementally updated and refined as search progresses. We have developed a Bayesian Optimisation toolkit in Python, using OpenFOAM as a CFD engine, and demonstrated its utility on a number of engineering and industrial test cases. We will present an overview of the Bayesian Optimisation process and its application for a number of cases including heat exchangers, draft tubes and particle separators.