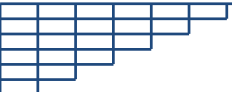


ME527 – Introduction to Engineering Optimisation 2021-22 – Coursework Bi-Objective Optimisation of Expensive Functions

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The problem

As attachment you have two functions:

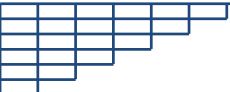
- the **problem** function in the routine *ExpModel.p* (*expensive*), and
- the **auxiliary** function in the routine *AuxModel.p* (*not expensive*)
-

Both functions take as input a design vector bounded as

- Lower bounds $LB = [0, 0, 0, 0, 0, 0]$
- Upper bounds $UB = [10, 50, 200, 1000, 5000, 20000]$

and gives as output a vector, \mathbf{F} , of two elements: $[F(1), F(2)]$

The final aim of the work is minimising both $F(1)$ and $F(2)$ given by the expensive routine *ExpModel.p*



The steps to perform are:

- a) Implement a strategy (NO surrogate based) to find a good approximation of the ENTIRE Pareto front with at most 50000 function evaluations using the auxiliary function in the file *AuxModel.p*; the strategy should be reliable and should be tested on **10 independent runs** (if a stochastic method is used).
- b) Implement a SURROGATE based strategy to find a good approximation of the ENTIRE Pareto front with at most 300 function evaluations of the true auxiliary function in *AuxModel.p*; the strategy should be reliable and should be tested on **10 independent runs** (if a stochastic method is used)
- c) Use the SURROGATE based strategy developed at point b) to find the best approximation of the true Pareto front for the problem function implemented in *ExpModel.p* (the expensive routine) with at most **300 function evaluations** of the expensive function.



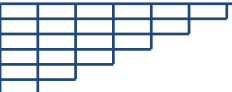
REPORT

You are required to write a very short report not exceeding **1500 words** (excluding appendix).

Your report should include the following features:

- *description of the NON-surrogate based global search strategy* (just the name of the algorithm is not enough - you should mention and describe the main steps of the algorithm – an algorithmic form would be appreciated);
- *description of the SURROGATE based global search strategy* (just the name of the algorithm is not enough - you should mention and describe the main steps of the algorithm – an algorithmic form would be appreciated);

...

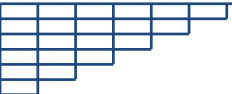


REPORT

...

- *results* of all the optimisation processes, reporting:
 - for point a) the achieved 10 approximations of the Pareto front (clear figure), and the computational cost of the optimisation.
 - for point b) the achieved 10 approximations of the Pareto front (clear figure), and the computational cost of the optimisation.
 - for point c) the achieved approximation of the Pareto front (clear figure and table of results), and the computational cost of the optimisation. Make sure that you report/show the Pareto front of the true function and not that of the surrogate (**i.e., verify the final results of the surrogate, with the true function, this will not be counted as part of the 300 budget**)
- *discussion* on the obtained results, including the analysis of the performance of both strategies (NON-surrogate based and SURROGATE based), and the use of the surrogate based approach to solve the expensive problem;

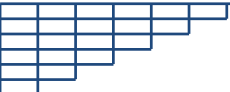
SUBMISSION: 1) one Word/PDF file containing the report, and 2) one compressed file containing all the routines.



Marking criteria

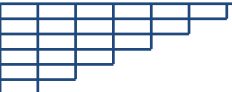
Assessment criteria (total marks: 100)

- Description of the global search strategies (clarity, **effort**, and logic; for both cases there should be the explicit description of the global exploratory and local exploitative parts) - report i) & ii) – **50 Marks**
- Results (correctness/goodness and clarity) – report iii) – **30 Marks**
- Final discussion (correctness and clarity) – report iv) – **20 Marks**
- Appendix – **NOTE:** all the routines and instructions to use them should be "run ready", i.e., the lecturer should be able to run the main script(s) and replicate your results; if that cannot be done, marks will be penalised.



Due date

Thu, 31 March 2022, 3:00 PM





University of **Strathclyde** Glasgow