POSTER 18

CMAC FUTURE MANUFACTURING RESEARCH HUB

Many-objective process optimisation with constraints for continuous tableting lines: a case study in lovastatin

Kai Eivind Wu[1] **k.e.wu@sheffield.ac.uk**

Cameron J. Brown[2], Murray N. Robertson[2], Blair F. Johnston[2], George Panoutsos[1]

[1]University of Sheffield, Department of Automatic Control and Systems Engineering

[2]EPSRC CMAC Future Manufacturing Research Hub, University of Strathclyde, Glasgow, UK

Problem definition

Background: Digital design, assisted by data science, experienced significant progress over recent years within the continuous manufacturing in the pharmaceutical sector.

Research Objective: The project focuses the fundamental research on robust numerical and visual performance indicators for assessing performance for many-objective optimisation algorithms under multiple constraints

Methods: A surrogate model-based machine learning algorithm is used, to train data-driven models that capture the manufacturing process behaviour. Then use optimisation algorithms to get optimal solutions.

Results: >75% dissolution release could be achieved in 45 minutes.

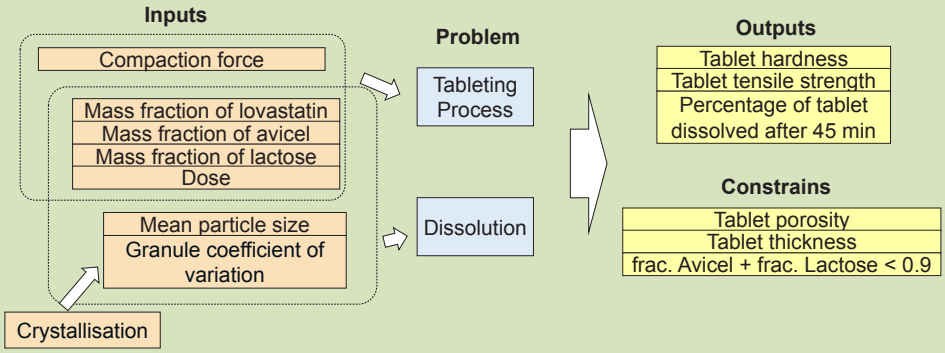
Data Collection

Establish model

Optimisation Algorithm

Results

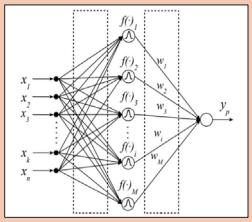
Problem Definition



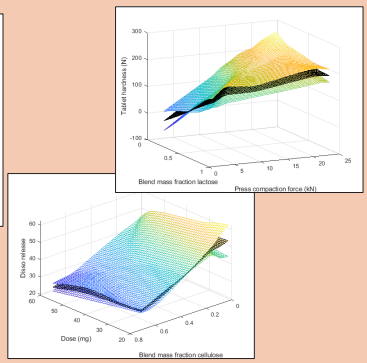
Data Collection

- Sample relevant data according to the design of the experiment, either from previous history or new experiments.
- The data should be organized and pre-processed before modelling.
- Data types include input, output and constraints.
- The maximum and minimum values (box constraints) for each input value need to be determined.

Establish Surrogate Model



Radial Basis Function Neural Network (RBFNN)

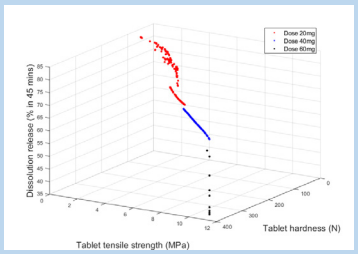


Evolutionary algorithms for optimization analysis - PPS

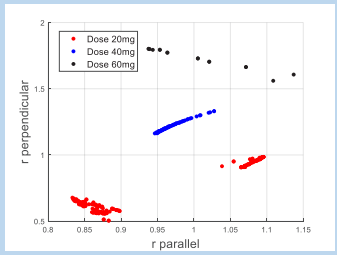
Initialisation → Selection → Crossover → Replacement → Evaluation → Mutation → Fittest Solution Presented

Results

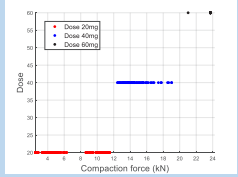
- The optimal solutions are verified.
- If the solution does not match the expectations, the models are re-trained and updated, and the process is repeated until satisfactory results are obtained.

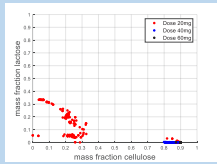


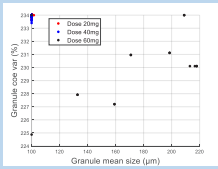
Objective space - Pareto Front



Input space - ProD







Input space - Scatter plot

Acknowledgements: This work was funded by the EPSRC Future Manufacturing Research Hub in Continuous Manufacturing and Advanced Crystallisation (CMAC, EPSRC grant number: EP/P006965/1) and the Engineering and Physical Sciences Research Council, through the project Feasibility Studies of Advanced Manufacturing Technologies.