

## Multi-stage and multi-objective process optimisation

A common problem in process design is the selection of optimal operating condition, which involves considering simultaneously multiple response (output) variables. This type of problem is known as multiple response optimisation (MRO) problems. Multiple response problems are quite prevalent across various disciplines of science and engineering. In this context, responses are the quality characteristics which attribute to the quality of a process or product. In this context, responses may be categorised into three different types, viz. larger-the-better (LTB), smaller-the-better (STB), and nominal-the-best (NTB).

For LTB type of response, the value of response is expected to be higher than the lower specification bound (target) on response. For smaller the better type response, the value should be lower than the upper bound on response. In case of nominal-the-best type of response, the value of response should be at the specified target value with minimum variance. Responses are affected by the set of input process conditions (variables).

However, a set of optimal input conditions for

a particular response may not be optimal for some other response. Thus, a trade-off solution is inhabitable in MRO problem.

In case of manufacturing or service processes, MRO problems are quite prevalent. Manufacturing product or service delivery may be a single-stage or multi-stage processes. In single isolated stage process, desired finished product or service is completed after a particular stage. Whereas, in multi-stage process, finished product / service is attained after passing through multiple interdependent stages. The most challenging aspect for MRO problem is attaining optimal (or near-optimal) process condition for interlinked multiple stages. Researchers had demonstrated that optimising each stage in isolation may not assure optimality of entire multi-stage process due to cascade effect. An interdependent multistage process is shown in the figure.

Our research group works to determine multi-objective trade-off near optimal solutions for multi-stage MRO problems in manufacturing and service environment.

