

16.5.1 Introduction to Model Predictive Control

MPC is a multivariable advanced control technique which uses a mathematical model to predict and optimise the future process behaviour.⁹ The basic structure of MPC is shown in Figure 16.12.

The MPC algorithm computes a control sequence by solving online, at each sampling instance, a mathematical optimisation and the first control action in this sequence is then applied to the plant.¹⁰ The optimisation problem typically involves a cost function of the following form:

$$J = \sum_{i=1}^N (y_{k+i} - y_{des})^T Q (y_{k+i} - y_{des}) + \Delta u_{k+i-1}^T R \Delta u_{k+i-1} \tag{16.4}$$

Subject to the constraints:

$$u_L \leq u \leq u_H \tag{16.5}$$

Where y_k is the controlled variable (CQA) at time k (e.g. concentration), y_{des} is the desired value, u_k is the control action (e.g. pump speed), N is the prediction horizon, and Q, R represent the cost function weights.

MPC offers several advantages over traditional control schemes, including the ability to explicitly take account of process constraints, as well as to handle

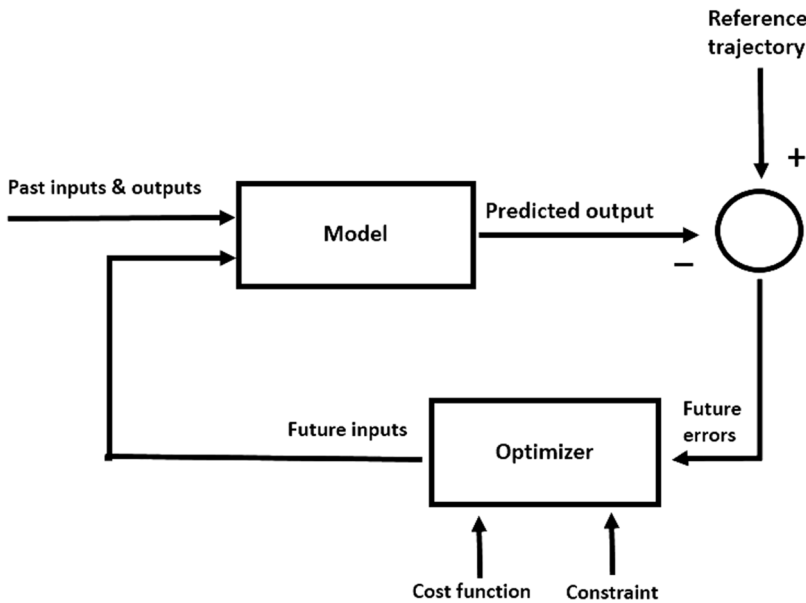


Figure 16.12 Structure of MPC.