Model-based bioreactor optimisation based on hybrid first principles/artificial neural network dynamical models

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Abstract
In this paper a methodology is proposed for bioreactor batch-to-batch optimization based on hybrid first principles/artificial neural network models. The method does not require the knowledge of the kinetics, which are modelled with neural networks. The reliability of the neural network components is monitored with a cluster-based technique during the optimization procedure. The optimization is realized numerically with a genetic algorithm but a penalty term is included in the objective function definition for neural network outputs beyond the domain of experience. Several simulation studies showed that the optimization could be carried out with only a very limited number of experiments and thus the proposed technique broadens the application of the hybrid approach to ‘newer’ processes with higher potential for optimization and with fewer data available than ‘old’ processes.

Keywords: hybrid modeling, artificial neural networks, dynamical optimization, bioprocess optimization