Identification and predictive control of spray tower system using artificial neural network and differential evolution algorithm

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Abstract

Increasing demands for high precision environmental protection measures regarding particulate matter (PM) emission from industrial productions and non-linear characteristics of spray tower system lead to the application of an intelligent control technique to adequately deal with these complexities. This includes the use of an artificial neural network (ANN) based predictive control strategy and differential evolution (DE) optimization algorithm to determines the optimal control signal, uk (liquid droplet size, d_D) by minimizing the cost function such that the output is set below the allowable PM concentration. A recurrent neural network (RNN) based on non-linear autoregressive with exogenous inputs (NARX) model has been used to develop the dynamic model of the system. The data for the training was obtained from empirical model of a spray tower system which involved 500 data sets representing the process input and the output PM concentration. The control process was implemented using MATLAB code by considering two DE optimization strategies; DE/best/1/bin and DE/rand/1/bin. The effectiveness of the controllers was demonstrated for different iterations by tuning the control parameters such as the prediction horizon, weight factor and control horizon. From the control response, it can be seen that the controller for the DE/rand/1/bin does a very good job of controlling the PM below the WHO allowable emission rate of 20g/μm

Keywords: Poles and towers, Training, Optimization, Prediction algorithms, Artificial neural networks, Mathematical model, Liquids

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