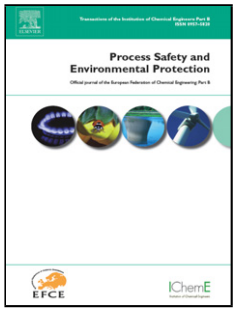

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Monitoring of Wastewater Treatment Plants using Improved Univariate Statistical Technique

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Abstract

Proper operation of the wastewater treatment plants (WWTPs) is crucial in order to maintain the sought effectiveness and desirable water quality. Therefore, the objective of this paper is to develop univariate statistical technique that aims at enhancing the monitoring of wastewater treatment plants using an improved particle filtering (IPF)-based multiscale optimized exponentially weighted moving average chart (MS-OEWMA). The advantages of the developed technique are fivefold: i) estimate a nonlinear state variables of WWTPs using IPF technique. The IPF method yields an optimum choice of the sampling distribution, which also accounts for the observed data; ii) use the dynamical multiscale representation to extract accurate deterministic features and decorrelate autocorrelated measurements. iii) develop an optimized EWMA (OEWMA) based on the best selection of smoothing parameter (λ) and control width L; iv) combine the advantages of state estimation technique with MS-OEWMA chart to improve the fault detection in WWTP systems; and v) investigate the effect of fault types (offset or bias, variance and drift) and fault sizes on the fault detection performances. The developed technique is validated using simulated COST wastewater treatment BSM1 model. The BSM1, provided by the IWA Task Group on Benchmarking of Control Strategies, is a simulation platform that allows for creating sensor faults disturbances in a wastewater treatment plant. The detection results are evaluated using three fault detection criteria: missed detection rate (MDR), false alarm rate (FAR) and average run length (ARL_1).

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