Parallel Hybrid Modeling Methods For a Full-scale Wastewater Treatment Plant

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Parallel hybrid modeling methods are applied to a full-scale biological wastewater treatment plant. Within the hybrid model structure, a mechanistic model specifies the basic dynamics of the relevant process and a non-parametric model compensates for the inaccuracy of the mechanistic model. First, a simplified mechanistic model is developed based on Activated Sludge Model No. 1 and the specific process knowledge of the wastewater treatment process. Then, the mechanistic model is combined with five different non-parametric models-feedforward back-propagation neural network, radial basis function network, linear partial least squares (PLS), quadratic PLS and neural network PLS (NNPLS)-in parallel configuration. The performance of each parallel hybrid model is compared based on their ease of model building, prediction accuracy and interpretability. For this application, the parallel hybrid model with NNPLS as non-parametric model gives far better performance than other parallel hybrid models. In addition, the NNPLS model is used to analyze the behavior of the operation data in the reduced space and allows for fault detection and isolation.