RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Foundational Control Methods For Water Treatment Systems

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Challenge

Water treatment processes are difficult to optimize due to (a) difficulties in predicting abnormal feed water and process conditions, (b) challenges in water quality measurements, and (c) the need to account for equipment and safety constraints as well as contractual obligations. Significant efforts have been made to model water processes based on fundamental process understanding (termed physico-chemical modeling); however, this type of model cannot predict rare events that can cause catastrophic failures. In addition, such models are difficult to maintain, particularly following changes in infrastructure and/or manual operations. To account for this, our project is focused on the development of reliable, empirical models. This type of model gathers data from sensors and equipment in a facility to build and update the model. Through this project, we evaluate the utility of this data-intensive approach and integrate it into a closed-loop control framework for online/real time process optimization with limited to no need for process-specific detail.

Research Approach

This project focuses on developing approaches and methods for online model identification that enable autonomous monitoring, control, and optimization of decentralized, remote, and unstaffed water/wastewater treatment systems. The project is focused on demonstration of the fundamental capacity to perform process optimization with generic, empirical models. Specific tools developed in this project are aimed at (a) robust, real-time denoising of online sensor data, (b) automated model building and updating, and (c) process optimization through model-based control mechanisms. In this project, we used a pilot-scale closed circuit reverse osmosis (CCRO) desalination system as our testbed. In a follow-up project, we will be using a mobile demonstration-scale direct potable reuse (DPR) system (6 processes in series) as our testbed to develop new empirical models.

Impact

Overcoming the barriers of empirical-based modeling will lead to the development of general models that could enable a plug-and-play type of deployment for any water treatment process. Implementation of such generic models will enable far-reaching optimization of water treatment processes, including energy and operational costs.

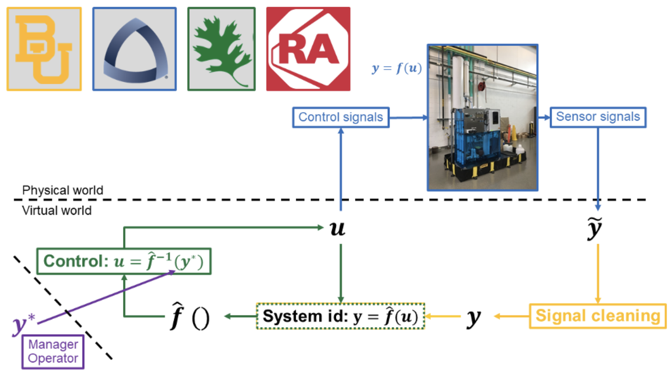

Figure 1. High-level view of data-intensive control architecture based on empirical model building and updating.

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REFERENCES

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