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Subsystem decomposition and distributed moving horizon estimation of wastewater treatment plants

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Abstract

In this work, we propose a subsystem decomposition approach and a distributed moving horizon estimation (MHE) method for wastewater treatment plants. While the proposed approach is general, Benchmark Simulation Model No.1 for wastewater treatment plant is considered. The plant is decomposed into smaller subsystems based on structural closeness. Three subsystems are formed considering subsystem interaction and nonlinearity of the subsystems. An iterative distributed MHE scheme is proposed for the wastewater treatment plant. Innovation triggered evaluation of the local MHEs is used to reduce the computational complexity of the estimation scheme. Extensive simulations are performed to illustrate the effectiveness and applicability of the proposed subsystem decomposition and distributed estimation methods.

Keywords: Distributed state estimation, process decomposition, subsystem configuration, nonlinear systems.

1 Introduction

Wastewater treatment plants (WWTPs) are commonly used for the disposal of wastewater to substantially reduce the environmental impacts of wastewater and to convert wastewater to reclaimed water [1, 2]. A WWTP which typically consists of several interconnected operating units, is a nonlinear process where complex physical and biological phenomena take place. The influent flow rate

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