

Simulate Your Way out of a Difficult Real Time Control Problem: Automatically Controlling Gates to Reduce Combined Sewer Overflows (CSOs)

Maxym Lachance^{1*} and Sid Lodewyk²

¹Tetra Tech - 5100 Sherbrooke Street East, Suite 900, Montréal, Québec, H1V 3R9, Canada

(*correspondence: maxym.lachance@tetrattech.com)

²City of Edmonton - 12810 58 Street NW, Edmonton, T5A 4L3, Canada

FORMAT

6-12 page paper plus 35-minute presentation

KEYWORDS

Real Time Control, Offline Simulation, Matlab, Control System Upgrades, Process Optimization, Waste Water Challenges, PID.

ScheduleABSTRACT

In an effort to reduce combined sewer overflows (CSOs), the City of Edmonton implemented real time control (RTC) at the RTC#4 site in order to control flows and take advantage of the available inline retention. However, the site demonstrated operational issues, such as process instability and excessive gate movements. Previous attempts to stabilize control were performed but the issues persisted, therefore a new methodology and tool were used to develop a control strategy that was successful, resolving the site's issues.

The new methodology consisted in a Matlab[®] simulator programmed to mimic the actual hydraulic conditions found on site, which took into account all of the equipment and hydraulic specifications (i.e. transient effects, flow lamination, actuator speed, gate size, instrumentation location, etc.). The Matlab simulator allowed for the testing of various control strategies until a valid and optimal control strategy was developed for the RTC#4 site without having to perform any physical change to the site. In the final phase, the optimal control strategy was programmed and implemented onsite at RTC#4, followed by a period of performance evaluation, confirming that the actual operational results were as anticipated. The setpoint overshoot was reduced by 82% from ± 40 cm to only 0 cm to 7 cm, the upstream level oscillation was reduced by 80% from ± 50 cm (1.0 m span) to only ± 10 cm, and the downstream level oscillations were reduced by 80% from ± 25 cm (0.5 m span) to only ± 5 cm.

The purpose of this paper is to demonstrate that it is possible to perform off site simulations to develop and fine-tune proportional, integrative and derivative (PID) controllers for difficult real time applications. This methodology can provide optimal performance without the limitation of onsite testing, where the different hydraulic conditions required for the testing are not all likely to be met during the testing period and may result in undesirable and risky outcomes (i.e. overflows, high water level, surcharge, etc).

About the Authors:



Maxym Lachance, Eng. is a project engineer with Tetra Tech, holding a college degree in electronics and a bachelor's degree in automated production engineering (Montreal). He has more than 12 years of experience as both an electronic technician and an engineer, and has developed an expertise in instrumentation and control. Mr. Lachance has successfully commissioned and calibrated more than eight different wastewater real time control (RTC) sites while providing assistance and guidance for many more. He most recently increased his expertise in off-site simulation using the Matlab[®] platform to resolve difficult RTC applications, as a result winning the "2012 Technical Achievement Award" in recognition of innovative technical excellence by the Tetra Tech organisation.



Sid Lodewyk, M.Sc., P.Eng. is a General Supervisor at the City of Edmonton (Alberta, Canada) with over 25 years of experience as a municipal engineer. He has worked in various positions at the city including planning, monitoring and operating. He is currently in charge of a group of 40 engineers, technologists, electricians, millwrights and repairmen who operate and maintain the 200 mechanical facilities that form an integral part of the sewerage and drainage systems in the City. There are two RTC facilities in the City for CSO control with a third in the final stages of construction.