

Water quality based management of smart urban drainage systems

Summary

Urban drainage systems (UDS) are being placed under greater stress due to rapid urban development and changing climate bringing along more frequent extreme rainfall events. This will increase the load to the existing UDS causing the risk of floods and outflow of pollutants to the environment. The objective of the thesis is to develop and test a decentralized water quality based model predictive control approach that enables to make the existing UDS controllable, utilize the free capacity of the system more efficiently and decrease the release of pollutants to the environment.

Research field:	Building and Civil Engineering and Architecture
Supervisor:	Ivar Annus
Availability:	This position is available.
Offered by:	School of Engineering Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between September 01, 2020 00:00 and October 02, 2020 23:59 (Europe/Zurich)

Description

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Climate change will have a considerable impact on urban areas. One of the consequences is the increase in peak storm water intensities and local extreme weather events that place the existing urban drainage systems (UDS) under great stress. The peak intensities are already now exceeding the UDS design threshold values resulting in increasing number of flood events in urban areas.

It is not financially realistic nor hydraulically reasonable to rebuild all the drainage systems to cope with the new climate conditions. Therefore a change in paradigm is needed to shift from reactive to proactive control of UDS.

This can be achieved by applying real time control (RTC) on UDS. State-of-the art RTC systems are mostly operated on quantity based control approach by implementing rule based, model predictive, decentralized model predictive or a combination of the abovementioned control approaches. The concepts of pollution-based RTC have mainly remained in theoretical level but showing high potential and applicability in preventing untreated wastewater spillages.

The objective of the thesis is to develop a pollution based RTC algorithm for a decentralized plot based RTC platform (DEPART).

This platform enables to control the inflow at the upstream catchments in order to minimize the risk of flood and pollution at the downstream of UDS. The platform will be built on top of the existing SWMM5.1 simulation engine.

Responsibilities and tasks:

- Assessment of the water quality based model predictive control approaches for the urban drainage system management
- Development of decentralized water quality based model predictive control approach for climate proof smart city
- Validation of the developed approach in real life case studies
- Active participation in work group projects (DEPART, CleanStormWater) and preparing new project proposals

Qualifications:

Master degree in either water engineering, environmental engineering or informatics.

The applicants should fulfill the following requirements:

- Knowledge in basic hydraulics and hydromechanics
- Knowledge in water quality requirements in urban water systems, main sources and pollutants
- Knowledge of Estonian and EU legislation on urban water system planning (national and regional level) and storm water management

- Good skills in programming languages (e.g. Microsoft C++ and/or Visual Basic)



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