Dissertation Outline

Chapter-1

Building a theory for smart stormwater systems

A simulation framework to integrate existing stormwater modelling tools under a common library. We demonstrate the use of this framework in a real-world inspired water quality example.

Chapter-2

Shaping streamflow in real-time using a sensor-actuator network

Using the data from a wireless sensor-actuator network, we characterize the behavior of a physical stormwater network and control it to attenuate peaks flows at the watershed outlet. We illustrate the use of sensor information for precisely shaping the response of a watershed, despite the lack of a physical model.

Chapter-3

Deep reinforcement learning for the control of stormwater networks

Formulation of reinforcement learning-based controller for maintaining the flows in a stormwater network below a desired threshold. Sensitivity of the control approach to the formulation of the reward function, neural network architecture, and scalability are evaluated to quantify the strengths and limitations of the control approach.

Chapter-4

Bayesian Optimization for shaping stormwater flows

We formulate a Bayesian Optimization based controller, that identifies the appropriate control strategy based on the incoming stormevent, and analyze the feasibility, scalability, and efficiency of the proposed control approach.

Chapter-5

Embedding hydraulic travel time into reinforcement learning algorithms

By redefining the state in the reinforcement learning controller to include the hydrograph, we are able improve control performance and learning efficiency. Use of hydrographs enables us to explicitly incorporate planning into the controller's decision process and coordinate the responses of spatially distributed assets.

Chapter-6

A simulation sandbox for the development and evaluation of stormwater control algorithms

We create a curated collection of the stormwater scenarios for quantitatively evaluating the performance of real-time control algorithms. These scenarios are coupled with a streamlined programming interface and a collection of online tutorials to make stormwater control more accessible to the research community.