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Towards robust optimal design of storm water systems

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In this study the focus is on the design of a storm water or a combined sewer system. Such a system should be capable to handle properly most of the storm to minimize the damages caused by flooding due to the lack of capacity of the system to cope with rain water at peak times. This problem is a multi-objective optimization problem: we have to take into account the minimization of the construction costs, the minimization of damage costs due to flooding, and possibly other criteria.
One of the most important factors influencing the design of storm water systems is the expected amount of water to deal with. It is common that this infrastructure is developed with the capacity to cope with events that occur once in, say 10 or 20 years – so-called design rainfall events. However, rainfall is a random variable and such uncertainty typically is not taken explicitly into account in optimization. Rainfall design data is based on historical information of rainfalls, but many times this data is based on unreliable measures; or in not enough historical information; or as we know, the patterns of rainfall are changing regardless of historical information.
There are also other sources of uncertainty influencing design, for example, leakages in the pipes and accumulation of sediments in pipes.
In the context of storm water or combined sewer systems design or rehabilitation, robust optimization technique should be able to find the best design (or rehabilitation plan) within the available budget but taking into account uncertainty in those variables that were used to design the system. In this work we consider various approaches to robust optimization proposed by various authors (Gabrel, Murat, Thiele 2013; Beyer, Sendhoff 2007) and test a novel method ROPAR (Solomatine 2012) to analyze robustness.
References
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