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Master Thesis Abstract

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Multiobjective Optimization of Decentralized Urban Drainage Networks using Simplified Cost and Resilience Indices

It is becoming ever more important that urban drainage systems are designed to be resilient to future challenges while still being cost-wise and computational affordable. Current conventional centralized design methods are proven to be insufficient to handle extreme weather events, population growth and urbanization. Promising new multiobjective approaches in literature to incorporate resilience into decentralized urban drainage system design have been introduced, but form complex and time consuming to solve problems. A multiobjective optimization of urban drainage systems considering degree of centralization, resilience and cost forms a non-linear multi-modal optimization with several highly constrained simultaneously-solved sub-problems. As a response this thesis introduces simple cost and resilience indices that can be used as heuristic parameters for multiobjective optimization of sewer layout design. Use as a heuristic parameters allows for a so-called prescreening of layout designs before the hydraulic optimization step. This leads to a reduction in the number of solutions needed to be computed. The sewer layout in flat areas significantly influences the construction and operational costs as well as reliability of the network performance, because there are no natural slopes to help with drainage. To solve this problem, a multiobjective optimization is conducted using NSGA-II algorithm coupled with layout generating algorithms, the Loop by Loop Cutting algorithm and the Hanging Gardens algorithm, and the simple cost and resilience indices. Next the hydraulic design optimization of the chosen layouts is conducted using a self-adaptive design algorithm for sizing sewers, and subsequently the life cycle costs are calculated. To demonstrate the application and advantages of the proposed model, a case study in the south-west city of Ahvaz, Iran is explored. It is found, that inherently designing for structural resilience in sewer layout design positively influences the functional resilience of the sewer system design while also increasing life cycle costs. Lastly, the proposed model is proven to be computational low cost, as it intrinsically reduces the number of optimization iterations needed for convergence.