



## **A simulation-optimisation approach for designing water distribution networks under multiple objectives**

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Especially in arid and semi-arid regions, water distribution networks are of major importance for an integrated water resources management in order to convey water over long distances from sources to consumers. However, to design a network optimally is still a challenge which requires an appropriate determination of: (1) pipe/pump/tank characteristics - decision variables (2) cost/network reliability - objective functions including (3) a given set of constraints. Thereby, objective functions are contradicting, which means that by minimising costs network reliability is decreasing resulting in a higher risk of network failures. For solving this multi-objective design problem, a simulation-optimisation approach is developed. The approach couples a hydraulic network model (Epanet) with an optimiser, namely the covariance matrix adaptation evolution strategy (CMAES). The simulation-optimisation model is applied on international published benchmark cases for single and multi-objective optimisation and simultaneous optimisation of above mentioned decision variables as well as network layout. Results are encouraging. The proposed model performs with similar or better results, which means smaller costs and higher network reliability. Subsequently, the new model is applied for an optimal design and operation of a water distribution system to supply the coastal arid region of Al-Batinah (North of Oman) with water for agricultural production.