

# Optimization of sensor placement for water network contamination detection

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## Abstract

Municipal water distribution networks are complex systems in which contaminants can spread rapidly, making timely and effective detection a significant challenge. This project develops a simulation-based optimization framework to determine the most effective placement of a limited number of sensors within a water pipeline network. By modeling contamination events at random entry points and simulating their spread based on network flow dynamics, the system evaluates different sensor configurations using performance metrics such as detection rate and detection time. Multiple algorithmic approaches are explored to identify high-performing sensor placements under a fixed sensor budget ( $k$ ). Additionally, the project examines the tradeoff between cost and protection by analyzing how system performance changes with varying numbers of sensors. This work aims to provide a practical tool for improving water system safety and resilience through data-driven decision-making.

## Index Terms

machine learning, ML, piping system, contamination, design, sensor placement