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A new approach in simultaneous calibration of Hazen–Williams coefficients and demand of nodes in of water distribution systems

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ABSTRACT

Calibration is necessary to make models of water distribution systems (WDSs) perform similarly to actual events; however, calibration is often complicated and time-consuming. The present study provides a new approach for simultaneous calibration of Hazen–Williams coefficients and nodal demand using the hydraulic simulator of the WaterGEMS that includes fast messy genetic algorithm as the optimization tool. For WDS calibration, instead of optimization using extended period approach during a day, several hourly optimization problems are considered. This reduces optimization time and computational effort. In the proposed approach, pipes and nodes are classified by physical characteristics such as age and material and topology of the water distribution network. Classification of pipes and nodes makes the decision space smaller and makes it easier to find a solution in a reasonable time. The water distribution network was calibrated at each time step separately, and then, by aggregating the results, an optimal solution was achieved to minimize the difference between the measured performance and simulation results. The validity of the proposed approach was tested for a two-loop network, and its efficiency in complicated cases was evaluated through application to a part of the Tehran WDS. The results show that the proposed method can produce acceptable results in a reasonable time even for large and complicated WDSs. The case study under actual conditions showed that the difference between observed and simulated pressure at all nodes was <2 m and volume of computation decreased to 66.7%.

Keywords: Water distribution systems; Hazen–Williams roughness coefficients; Water demand; Genetic algorithm; Calibration

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