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Development of computational algorithms for daily water leak detection in district metered areas based on the principal component analysis

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ABSTRACT

Techniques for detecting leakage in water pipe networks have been developed worldwide in order to reduce unaccounted-for water quantity and enhance the reliability of the pipe networks. In this paper computational algorithms utilizing principal component analysis (PCA) were developed so that the algorithms can be used in a realistic water pipe network management situation in which the daily flow data of a district metered area (DMA) are needed to be verified for a possible relation with a water leak incident. For the improvement of the algorithms, it was assumed that a manager of a water pipe network uses these algorithms every day to test if yesterday's inflow data to a DMA were an outlier according to the PCA computational algorithm. The flow data used in this study were analyzed to determine the best flow data size for the field use of the developed PCA algorithm. For various flow data sets, which were defined as the smaller sizes of the flow measured in days than the whole data set available, a reference modeling for the PCA was applied to calculate the model outliers by moving the flow data sets day by day. For each DMA the effective outlier detection rates (EODRs) were calculated for the whole range of the defined time windows. The maximum effective outlier detection rate for a DMA was obtained as the maximum of the calculated EODRs. The process and results of the sensitivity analyses of the model parameters were used to suggest guidance on how to determine model parameters for a given flow data.

Keywords: Principal component analysis; District metered area; Water pipe network; Leak detection; Computational algorithm; Flow data

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