Water Network Partitioning for Smart Water Management

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(a) Purpose of study or research hypothesis
The study presents a framework for (1) automated creation of district metering areas (DMAs) in the water distribution network (WDN); (2) new objective functions for optimal layout design of flow meters and valves in water network partitioning (WNP).

(b) Key issue(s) or problem(s) addressed
The WNP is controlled by two phases, such as (1) clustering phase aiming to define the DMAs configuration, and (2) sectorization phase aiming to determine the optimal position and number of devices to achieve reliable DMAs layout. To create feasible DMAs and minimize the negative impacts of WNP in hydraulic performance, novel approaches are suggested in this study.

(c) Methodology or approach used
Here, a novel auto partitioning procedure is developed in which alternative factors, such as average pressure, water demand, elevation, and pipe diameter are integrated as the weights to create various DMAs scenarios based on the community detection algorithm (in clustering phase). Then, new objective functions are proposed based on the intrinsic relationship between energy, pressure, and leakage to optimize the location of flowmeters and valves minimizing the negative effects of the water network segmentation (in sectorization phase). Finally, several indicators are defined to evaluate the performance of WNP and for a comprehensive comparison of various DMA layouts.

(d) Results or conclusions derived from the project
The primary results reveal that the community structure algorithm can effectively define DMAs. It is also indicated that DMA layouts are influenced by the weights associated with nodes and pipes and the proposed objective function allows minimizing the reduction in energy consumption and leakage by WNP.

(e) Implications of the project relevant to congress themes
The WNP is the smart technology that divides the original network into independent DMAs, which enables early detection and management of water leakage and uniform control of pressure in large and complicated WDN. It provides the water utility with a useful decision-making process for the smart management of WDN.

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