Dynamic Configuration and Operation of District Metered Areas in Water Distribution Networks

Xuan-Khoa Bui*, Doosun Kang**

Abstract

A partition of water distribution network (WDN) into district metered areas (DMAs) brings the efficiency and efficacy for water network operation and management (O&M), especially in monitoring pressure and leakage. Traditionally, the DMA configurations (i.e., number, shape, and size of DMAs) are permanent and cannot be changed occasionally. This leads to changes in water quality and reduced network redundancy lowering network resilience against abnormal conditions such as water demand variability and mechanical failures. This study proposes a framework to automatically divide a WDN into dynamic DMA configurations, in which the DMA layouts can self-adapt in response to abnormal scenarios. To that aim, a complex graph theory is adopted to sectorize a WDN into multiscale DMA layouts. Then, different failure-based scenarios are investigated on the existing DMA layouts. Here, an optimization-based model is proposed to convert existing DMA layouts into dynamic layouts by considering existing valves and possibly placing new valves. The objective is to minimize the alteration of flow paths (i.e., flow direction and velocity in the pipes) while preserving the hydraulic performance of the network. The proposed method is tested on a real complex WDN for demonstration and validation of the approach.

Keywords: District metered areas, Dynamic configuration and operation, Water distribution network, Water network partitioning

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT－Ministry of Science and ICT), grant number NRF-2020R1A2C2009517.

* Member・Ph.D. Candidate, Dept. of Civil Engineering, Kyung Hee University・E-mail : khoabx@khu.ac.kr

** Member・Corresponding Author, Professor, Dept. of Civil Engineering, Kyung Hee University・E-mail : doosunkang@khu.ac.kr