Water Leakage Detection and Localization using Hydraulic Modeling and Classification

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ABSTRACT

A significant percentage of treated water is lost due to leakage in water distribution systems. The state of the art leak detection and localization schemes use a mixed approach of hydraulic modeling and data-driven techniques. Most of the works, however, focus on single leakage detection and localization.

In this research, we propose to use combined pressure and flow residual data to detect and localize multiple leaks. The proposed approach has two phases: detection and localization. The detection phase uses the combination of pressure and flow residuals to build a hydraulic model and classification algorithm to identify leaks. The localization phase analyzes the pattern of isolated leak residuals to localize multiple leaks.

To assess the performance of the proposed approach, different experiments were conducted using Hanoi water network benchmark. A realistic dataset is produced based on LeakDB benchmark's dataset preparation procedure. The result for a well calibrated hydraulic model shows that the detection of leaks is 100% accurate while localization is 90% accurate. The introduction of demand and noise uncertainty, however, affects the accuracy of the detection and localization. The proposed localization approach is also able to locate two to four leaks that existed simultaneously.

Keywords: Leakage Detection, Localization, Hydraulic Modeling, Classification, Combined residuals

Introduction

The urgency of managing challenges due to leakage in pipe networks has become greater in recent years due to water shortages caused by recent droughts, increase in demand along with environmental, social and political pressures (Dighade et al., 2014). The significance of leak detection stems from the fact that many water scarce and arid countries in the world have limited options for water resources development. Therefore, focusing on water supply and demand management options is deemed necessary as they offer more cost-effective and environmentally sound solutions (Mamlook and Al-Jayyousi, 2003). Although there is awareness that efficient management of water resources is a growing necessity, non-revenue water due to physical losses such as leakage is still excessive in many cities. A World Bank study states that the global estimate of physical water losses are about 32

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