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The Use of Correlation Difference for the Prediction of Leakage in Pipeline Networks

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Abstract : Anomalies such as water pipeline and hydraulic or petrochemical pipeline network leakages and bursts have significant implications for economic conditions and the environment. In order to ensure pipeline systems are reliable, they must be efficiently controlled. Wireless Sensor Networks (WSNs) have become a powerful network with critical infrastructure monitoring systems for water, oil and gas pipelines. The loss of water, oil and gas is inevitable and is strongly linked to financial costs and environmental problems, and its avoidance often leads to saving of economic resources. Substantial repair costs and the loss of precious natural resources are part of the financial impact of leaking pipes. Pipeline systems experts have implemented various methodologies in recent decades to identify and locate leakages in water, oil and gas supply networks. These methodologies include, among others, the use of acoustic sensors, measurements, abrupt statistical analysis etc. The issue of leak quantification is to estimate, given some observations about that network, the size and location of one or more leaks in a water pipeline network. In detecting background leakage, however, there is a greater uncertainty in using these methodologies since their output is not so reliable. In this work, we are presenting a scalable concept and simulation where a pressure-driven model (PDM) was used to determine water pipeline leakage in a system network. These pressure data were collected with the use of acoustic sensors located at various node points after a predetermined distance apart. We were able to determine with the use of correlation difference to determine the leakage point locally introduced at a predetermined point between two consecutive nodes, causing a substantial pressure difference between in a pipeline network. After de-noising the signal from the sensors at the nodes, we successfully obtained the exact point where we introduced the local leakage using the correlation difference model we developed.

Keywords : leakage detection, acoustic signals, pipeline network, correlation, wireless sensor networks (WSNs)
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