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AN AUTOMATED LEAKAGE DETECTION TECHNIQUE FOR WATER PIPELINE SYSTEMS

Abstract:
Leakages are one of the top concerns for water utilities all over the world. According to recent studies, at least 20% of treated freshwater is lost during transportation due to the pipeline leakages. Although contemporary leakage detection techniques are able to locate leakages in buried pipelines, they require skilled workforce, expansive equipment, and only offer a snapshot leakage status of the water pipeline system. In this paper, authors present a deep learning convolutional neural network (CNN) model to predict the leakage sizes using the flow-induced vibration data. The main objective of this study is to use the acceleration signal data collected with accelerometers to detect leakages. A two looped pipeline network which comprises a pump, reservoir of 820-litre capacity, varying pipeline diameters, burial conditions, various bends, Tjoints, leak simulators and a flowmeter is used to collect flow-induced vibration using accelerometers. Several leakage scenarios were designed and acceleration signal data from 12 locations is then converted into image format using continuous wavelet transformation (scalogram) plotted as a function of time and frequency. These images were used to train a CNN model with the help of AlexNet (pre-trained network). The final layers of AlexNet were modified according to the need of scalogram image data, and 80% of the total images were used to train and develop the CNN model. The trained model is used to predict the leakage scenarios of the remaining 20% of the images. The prediction accuracy of the trained CNN model is found to be approximately 92%. Predictive models would allow the water utility companies to monitor their water distribution system in near real time and detect leakages in the early stage to minimize the loss of treated freshwater.