Near Real-time Event Recognition in Water Distribution Systems

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United Utilities | Technology Strategy Board Driving Innovation

University of Exeter – Centre for Water Systems

Problem

Every day the water industry in the UK loses about 3,300 million litres of water through leaks and bursts thus making the timely and reliable detection of these events an important issue. Not only is the loss of treated and frequently pumped water a waste of a valuable resource, money and energy, but it is also a potential health risk due to potential of pollution ingress through cracks. Although large bursts can be easily detected, for most leaks and bursts the water doesn't appear immediately on the ground.

KTP

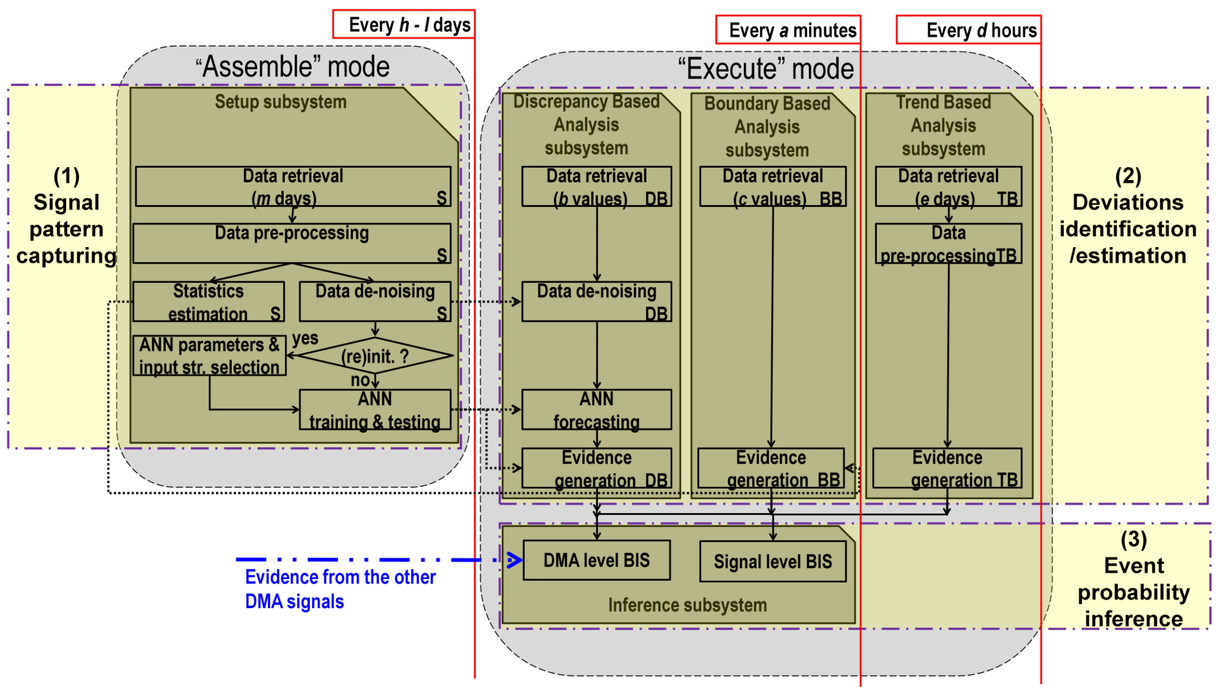
Knowledge Transfer Partnership (KTP) is a programme partially funded by the Technology Strategy Board which aims at helping businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK Knowledge Base.

The three year KTP between the University of Exeter and United Utilities (UU) aims at further developing and testing the recently patented (PATENT No. WO2010/131001) artificial intelligence based methodology that allows detection of leaks, bursts and similar events as they occur. The ultimate goal is to build a fully automatic Event Recognition System (ERS) to be used operationally across the business. This, in turn, will enable the water company personnel to react more quickly to the events occurring thus saving the water that would normally be lost, reducing the potential damage to the infrastructure and, most importantly, improving its operational performance and customer service by minimising interruptions to the water supply.

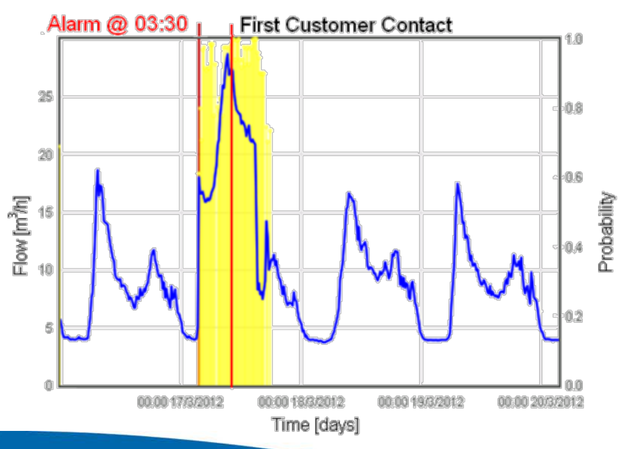
Methodology

The methodology enables event detection at the District Metered Area (DMA) level and works by simultaneously processing the near real-time pressure and/or flow signals coming from all the available DMA sensors. It consists of three principal data analysis steps:

1. *"Capture" the patterns of the pressure/flow signals assuming that no event occurred in the DMA;*
2. *Identify and estimate the event-induced pressure/flow deviations from the "captured" signal patterns;*
3. *Infer the probability that an event has occurred in the DMA based on the identified deviations.*



It provides the probability of an event occurrence together with an estimate of the event magnitude (e.g., burst flow rate) and the detection time. This information may enable the water company to further diagnose the incidents occurring, rank alarms and prioritise responses.



Successes to date

The methodology has been tested and verified on a number of UU DMAs. The results obtained have shown its ability to successfully detect events in a timely (within 30 minutes) and reliable manner (up to 100%). Further methodology developments are being carried out and a prototype ERS is currently used companywide.

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Romano, M., Kapelan, Z., and Savić, D.A. (2012). "Automated detection of pipe bursts and other events in water distribution systems." *Journal of Water Resources Planning and Management.* [Epub ahead of print doi:10.1061/(ASCE)WR.1943-5452.0000339].

Romano, M., Kapelan, Z., and Savić, D.A. (2013). "Evolutionary algorithm and expectation maximisation strategies for improved detection of pipe bursts and other events in water distribution systems." *Journal of Water Resources Planning and Management.* [Epub ahead of print doi:10.1061/(ASCE)WR.1943-5452.0000347].

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