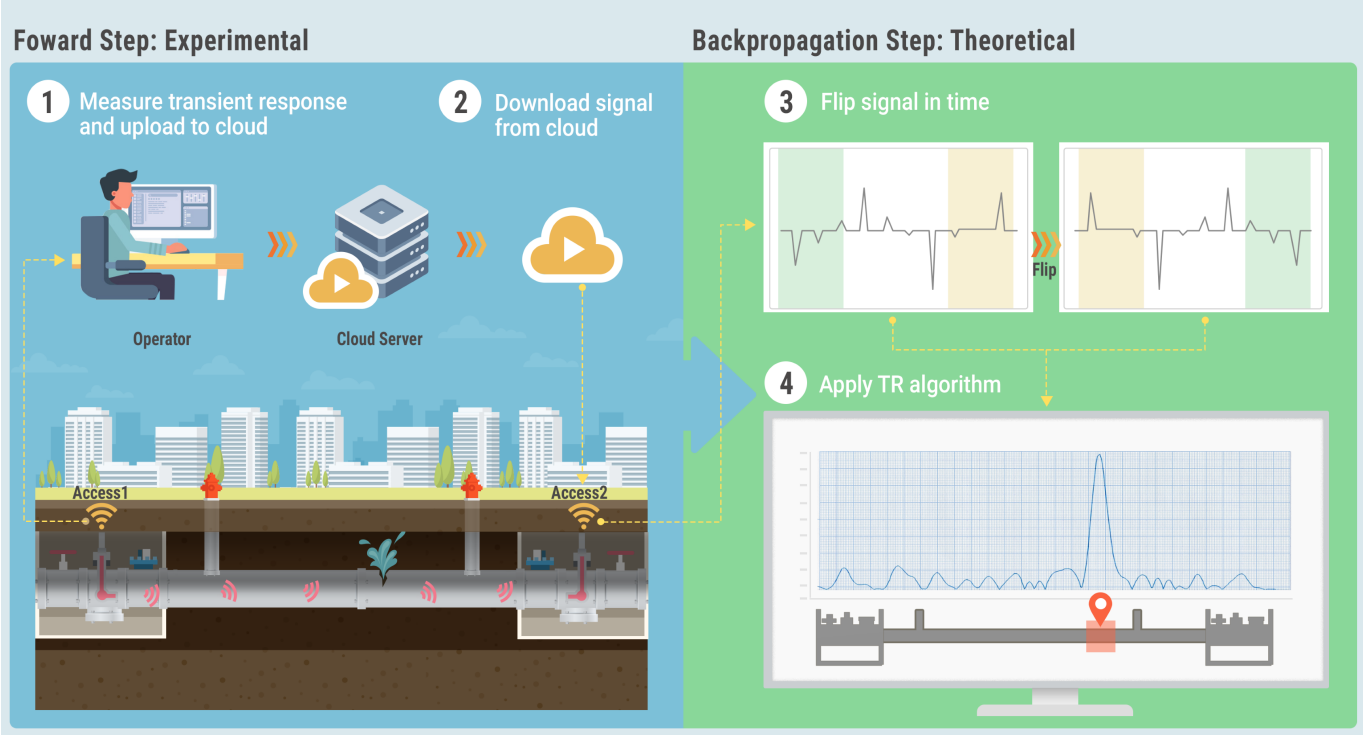
TECH OFFER

Time Reversal Technology For Pipelines Condition Assessment



KEY INFORMATION

TECHNOLOGY CATEGORY:
Sustainability - Sustainable Living
Environment, Clean Air & Water - Sensor, Network, Monitoring & Quality Control Systems
Infocomm - Big Data, Data Analytics, Data Mining & Data Visualisation
Infocomm - Smart Cities
Infocomm - Wireless Technology

TECHNOLOGY READINESS LEVEL (TRL): TRL6
COUNTRY: HONG KONG
ID NUMBER: TO175025

OVERVIEW

Urban pipeline systems are vital, large, long-lived, complex, largely inaccessible, and aging, fraught with deficiencies and inefficiencies that result in massive losses of water resources and energy use. Thus, they present an enormous challenge to making cities sustainable, adaptive, and carbon neutral.

This pipeline condition assessment technology is pioneered by experts who have leveraged advances in research and engineering science to deliver unique and optimal performances. The technology introduced the use of Time Reversal (TR) for defect detection and condition assessment of pipelines. In fact, TR technology is reliable, cost-effective, and has a long-range capability.

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It possesses the unique feature of providing high resolution while being non-intrusive and non-disruptive.

The TR technology can detect existing leaks, bursts, blockages, malfunctioning devices (e.g., air valve), pipe wall strength condition, and harmful transient. The software provides the following functionality:

- Active testing: Actively probing the system to control the resolution of localization
- Passive testing: To detect bursts and harmful transients
- Real time monitoring: To assesses system dynamics and demand patterns
- On-demand and automatically generated reports
- On demand sensor control and sensor expansion
- Flexible & High sampling rate

TECHNOLOGY FEATURES & SPECIFICATIONS

This technology enables the following features:

- Real-time autonomous remote monitoring
- Reliable, low cost and long-range
- Provides high resolution while being non-intrusive and non-disruptive - a unique technology feature
- Scalable for different pipe systems in terms of size, type and pipe material

This technology uses an in-house interactive software that integrates and controls an automated, distributed, cloud-based monitoring and diagnostic system, which comprises multiple high-sampling rate (>1000 samples/s) data acquisition systems, transducers, and control devices deployed at access points of the pipeline system. The installed devices perform synchronized measurements between access points with previously unattainable accuracy (microseconds) thanks to integrated GPS technologies. Data is uploaded at high rates to a cloud server via 5G connections. Therefore, this technology is able to perform diagnosis tests on demand. The data obtained is stored in the cloud and processed in real time with novel TR algorithms to evaluate the integrity of the pipeline system. Potential defects and pipe wall deterioration will be displayed graphically on a virtual map of the system. The designed diagnostic system is inherently scalable; thus, it is possible to add multiple measurement and control stations according to needs and the spatial extent of the pipeline system (e.g., the water distribution network).

POTENTIAL APPLICATIONS

This TR technology is scalable and, thus, can be implemented for different pipe systems (e.g., water supply systems, sewage rising mains, building pipes, district cooling systems) and for any pipe material.

Such a product is an evolution of SCADA systems for pipeline monitoring and condition assessment. The interactive software integrates the world's first real-time, fully automated, and autonomous TR-based technology for pipeline condition assessment, enabling the timely detection of defects in the district metering system to support proactive mitigation measures.

The smart urban pipeline system being developed incorporates IoT for managing pipelines, significantly reducing maintenance costs and extending the lifespan of urban systems.

This technology is advantageous for utility providers, designers, and asset management companies. Its application in developing estates and building pipes opens up an additional extensive market with the potential for high returns and exponential revenue growth.

MARKET TRENDS & OPPORTUNITIES

The regular expansion, replacement, and rehabilitation of urban pipelines present a substantial market and potential for implementing TR technology globally. Approximately 100 km/year of pipes are being added in Hong Kong, and over 40,000 km/year of pipes in Mainland China. Worldwide, millions of kilometres of urban water infrastructure will need to be added to supply the growing city populations, expected to expand globally by 2.5 billion by 2050. The replacement and rehabilitation of aging urban pipelines that exceed their service life are common practices in all urban pipeline systems. In Hong Kong, approximately HK$23.6 billion was spent on replacing 3,000 km of aged water mains from 2000 to 2015. The number of water main bursts dropped significantly, decreasing by about 98% from over 2,500 in 2000 to less than 150 in 2015, with a simultaneous reduction in the number of leaks. While Replacement and Rehabilitation (R&R) has proven effective in reducing pipe bursts, it is undeniable that the associated costs are high.

UNIQUE VALUE PROPOSITION

The design and management of urban pipeline systems are currently constrained by the absence of a diagnostic system for the relatively inaccessible buried pipelines. Among the existing diagnostic and defect detection systems, in-pipe technologies are the most reliable. However, recent trials in Hong Kong have revealed these technologies to be costly, disruptive, time-consuming, labour intensive, and, in some cases, inconclusive, especially for defects near junctions. Other non-intrusive methods, such as acoustic correlators and noise loggers, are low in cost, but these methods are hands-on, exhibit poor performance in localization, and incur a high rate of false alarms.

With the implementation of this TR technology, pipe defects (e.g., existing leaks, blockages, malfunctioning devices, pipe wall deterioration, etc.) can be detected before any serious burst occurs. As a result, the serviceable life of urban pipelines can be extended, and the costs for emergency repairs, replacements, and rehabilitation of urban pipelines can be significantly reduced. The implementation of this technology will also ensure that newly installed R&R pipes don't suffer the same wasteful and underperforming fate as current ones.

The TR technology is reliable, low cost and long-range, and it has the unique feature of providing high resolution while being non-intrusive and non-disruptive.