INTEGRATED LEAKAGE DETECTION AND LOCALISATION MODEL FOR NATURAL GAS PIPELINES

PROJECT SUMMARY

Leakages in gas pipelines pose significant safety concerns and challenges to operations. They need to be identified and located as soon as possible and with as little leakage as possible. It's especially crucial and challenging for existing underground pipelines such as the gas transmission pipelines in Singapore.

Objectives of this project:

i) Investigate an accurate, sensitive, fast and easy-to-retrofit method for leak detection and localisation in a high-pressure gas transmission pipeline, which was lacking in the market;
ii) Develop a prototype leak detection and localisation system; and
iii) Test and validate the developed prototype system in a physical setup.

The project aimed to enhance pipeline safety and reliability for oil and gas industry operators and contribute to elevating Singapore's technical and research capabilities in natural gas transportation.

Figure 1. Leakage detection and localisation test platform designed and developed under the funding project

PROJECT OUTCOMES

A reliable and computationally efficient model has been developed to detect and identify leakages and to pinpoint the location of the leakage in a high-pressure transmission gas pipeline network. The integrated leakage detection and localisation (iLDL) system employs an estimation technique that incorporates mass balance and leak-induced acoustic wave signatures. The developed system is able to achieve the following performance validated in a lab-scale setup as shown in Figure 1:

- Good sensitivity that is able to detect small leakage down to 0.62% of the operating gas flow rate;
- An accurate leakage localisation of within ±1% of pipeline length;
- Zero false alarms; and
- Fast reporting of leakage occurrence and its location within 1min for a 10 km pipe.

The developed system is fully automated and easy to retrofit - two sensors to be installed at one gas off-take station to monitor the pipe in-between two off-take stations, up to 10 km away.

The above features of the developed system will translate into timely and accurate emergency response. Operational safety of gas transmission pipelines can be significantly enhanced.

The project team is actively looking for commercialisation and productisation partners to bring the developed technology into market. In addition, the team is also looking into applying the developed technology for other leakage detection problems including water pipe leakages.

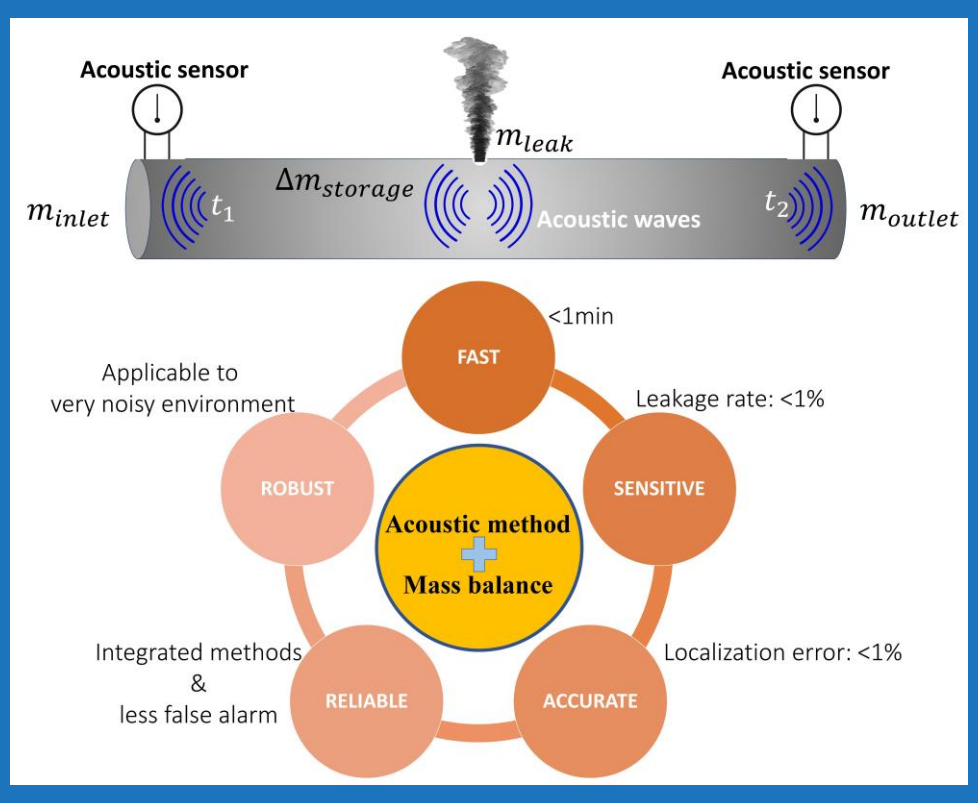

Figure 2 Achieved outcome of the integrated approach of acoustics and mass balance for leak detection and localisation

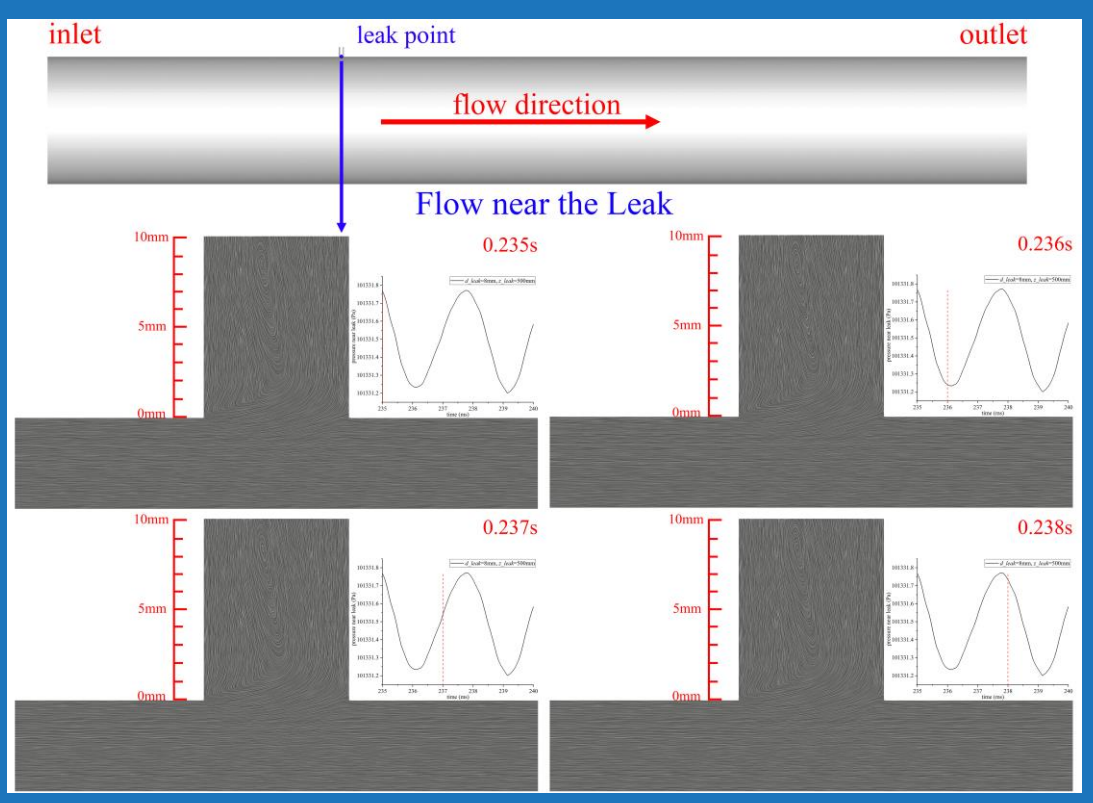

Figure 3 Fluid mechanism of gas leakage in high pressure gas pipelines

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