



Intelligent TPI Detection With Distributed Acoustic Sensing (DAS)

France

Project Overview

Teréga, a natural gas transmission system operator (TSO) in southwest France, evaluated the use of DAS on their natural gas pipelines to help protect them from third party interference (TPI). Unauthorized excavation is one of the key risks to pipeline integrity, which can be reduced using 24/7 DAS monitoring.

AP Sensing deployed its Distributed Acoustic Sensing (DAS) monitoring solution using a spare fiber within an existing telecom cable installed parallel to the pipeline. Combined with advanced machine learning, the system continuously monitors acoustic activity, classifies detected events, and provides precise location information for field verification.

The Challenge

DAS detects vibrations over long distances with high sensitivity. Along a typical pipeline corridor, however, most detected events are harmless. Agricultural machinery, forestry operations, road traffic, construction work, and even wildlife can generate acoustic signatures that appear similar to excavation activity.

For pipeline operators, the key challenge is not detecting every vibration, but identifying which events may require investigation. Excessive nuisance alarms increase workload and can reduce confidence in the monitoring system. Reliable classification is therefore essential to distinguish routine activity from potential threats to pipeline integrity.



Background

- gas pipeline network requires risk reduction by continuous monitoring
- Agriculture and traffic generate thousands of acoustic events
- Reliable classification is critical for effective monitoring

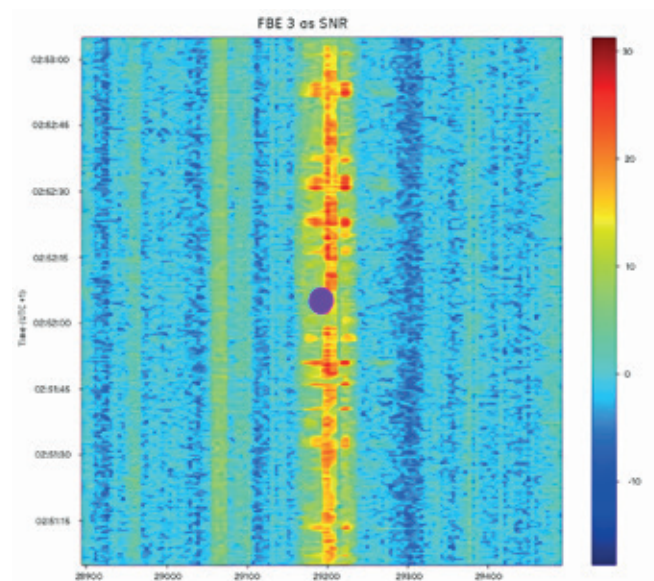


Solution & Benefits

- Distributed Acoustic Sensing (DAS) monitors the entire pipeline
- Machine learning classifies acoustic events in real time
- Reduced nuisance alarms and accurate event localization



Figure 1: Excavator at a non declared work on a farm triggered a real-time DAS alarm, also showing on the associated waterfall diagram.



The Solution

AP Sensing deployed a phase-sensitive DAS system using a spare fiber within an existing telecom cable running parallel to a Teréga pipeline. The system continuously monitored the full route with high spatial resolution, enabling real-time detection and localization of acoustic events.

To improve classification, AP Sensing combined DAS with advanced machine learning. Rather than relying on signal strength alone, the algorithms analyze the spatial and temporal characteristics of each detected event. This allows the system to distinguish excavation and other construction-related activity from routine environmental noise.

The classification models were trained using hundreds of controlled field trials together with operational data from monitored assets under a wide range of soil, installation, and environmental conditions. Fiber distance was correlated with GPS coordinates, enabling alarms to include precise location information for rapid field verification.

Implementation & Results

The project followed a structured validation approach. First, 90 controlled field tests were conducted using excavators, hydraulic jackhammers, augers, pile driving equipment, and manual digging at varying distances from the buried fiber optic cable. These tests provided reference data for evaluating detection performance and classification accuracy. Following commissioning, the system operated continuously for 18 months under real operating conditions.

During this period, it monitored thousands of routine events generated by agriculture, traffic, crossings, and other daily activity while successfully identifying both declared and undeclared construction activities along the pipeline.

Key results included:

- Successful detection and localization of 23 genuine mostly authorized third party interference events
- Reliable detection of excavation activities at distances of up to approximately 15 m from the fiber optic cable
- Reduction of nuisance alarms from an average of eight per month to 2.5 per month through continuous improvement of the machine learning models

The monitoring period covered the complete agricultural cycle, including soil preparation, planting, crop maintenance, and harvesting. This demonstrated reliable performance under changing seasonal and operational conditions.

Conclusion

The Teréga project demonstrates that Distributed Acoustic Sensing, combined with advanced machine learning, can reliably distinguish routine activity from potential threats under real operating conditions. The 18-month field evaluation confirmed accurate event classification while significantly reducing nuisance alarms, providing operators with reliable information to support pipeline integrity management.