

AgilFence^A

Fibre Optic Acoustic Sensing System for Pipeline & Buried Cable Protection



- Easy Deployment
- No blind zone along entire length of the pipeline
- Define the nature of intrusion
- Locate the event accurately

Empowering thru' Innovation





Benefits

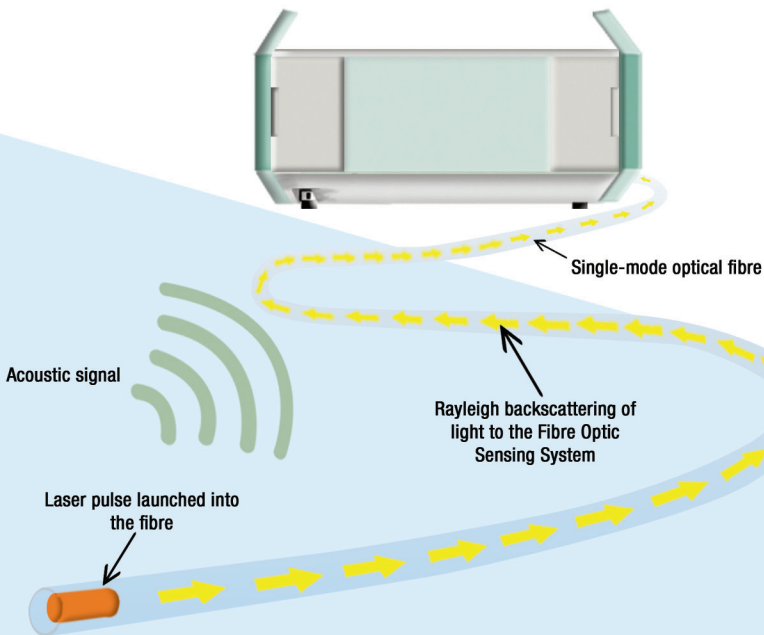
AgilFence^A is a distributed acoustic sensing system to record real-time sound signals along the entire length of the pipeline continuously without any blind points and interferences. It can monitor every points of the pipeline, locate the leakage and the third party intrusion event accurately, and identify the nature of the third party intrusion event. After analysing the sound signals (frequency, amplitude, and phase) received from the optical fibre, an alarm will be triggered if the event is a threat to the pipeline.

Key Features

- No blind zone along entire length of the pipeline
- Continuous interference-free monitoring
- Define the nature of intrusion
- Early warning to the threat to the pipeline
- No maintenance required
- Easy deployment

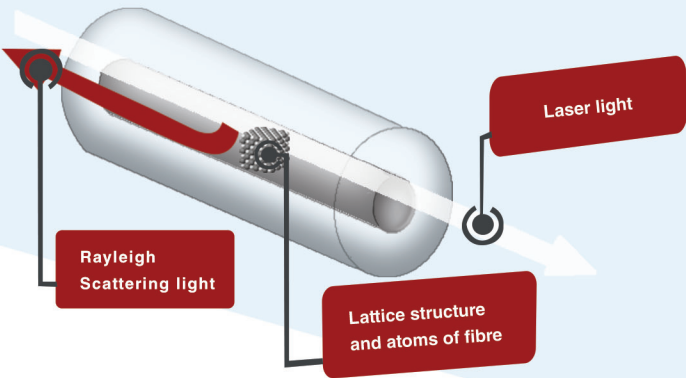
Applications

- Gas pipeline leakage detection
- Third Party Intrusion (TPI)
- Well integrity
- Pipeline Inspection Gauge (PIG) Tracking
- Seismic monitoring



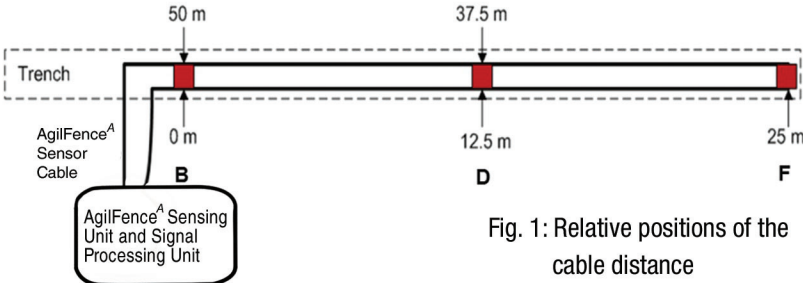
How it works

The AgilFence^A buried solution uses Phase-Sensitive Optical Time Domain Reflectometer (PS-OTDR) technology to achieve distributed acoustic sensing along an optical fibre cable up to 20 km. When a coherent laser pulse is launched into the fibre, the Rayleigh backscattering will occur. This backscattering received will be analysed by the AgilFence^A Sensing Unit and AgilFence^A Signal Processing Unit. By detecting temporary changes in frequency, amplitude and/or phase, AgilFence^A can pick up vibration or acoustic signals caused by excavation activities. As the distance the light travelled can be easily calculated from the time of travelling, the excavation activities can be located accurately. With intelligent signal processing, false alarm will be eliminated and true alarm will be triggered and displayed to the user.



On-site Testing Results

A trial was conducted along a busy road in Singapore. A fibre optic sensor cable has been buried underground 90 cm in depth to evaluate the system performance. A jackhammer was used to hit on the road (picture below) to simulate an excavation event.



Tests were conducted to determine the sensitivity of the buried fibre optic sensing cable and the spatial resolution for excavation events. Figure 1 shows the relative positions of the excavation points and the sensor cable distance (starting at 0 m and ending at 50 m in a loop).

S/N	Test Scenarios	Location	Detect?	25 m spatial resolution?	Remarks
1	Hammer head at B hitting cable position 0 m and 50 m concurrently	B	Y	N.A.	50 m spatial resolution achieved
2	Hammer head at D hitting cable position 12.5 m and 37.5 m concurrently	D	Y	Y	25 m spatial resolution achieved
3	Hammer head at B and F hitting cable position 0 m, 25 m and 50 m concurrently	B & F	Y	Y	50 m spatial resolution achieved

Table: Summary of Trial Results

For this trial, a detection is considered successful if the buried sensor cable can detect the excavation activity. A spatial resolution of 25 m is considered achieved if two detections spaced no more than 25 m apart are separately reported. The table above shows the results.

Performance Specifications*

Monitoring Distance	25 km
Accuracy	25 m
Spatial Resolution	50 m
Detection Range with P _d 90%	25 m

* Performance specifications for excavation on soil ground with low noise level

Technical Specifications

Interrogator System		
Technology	Phase-sensitive OTDR	
Input Voltage	12 VDC (100 ~ 240 VAC)	
Communication Interface	RJ45	
Operating Temperature	15 ~ 25 °C	
Operating Humidity	< 90%, non-condensing	
Fibre Sensing Cable		
Fibre Type	Single-mode four-core fibre	
Outer Sheath	Special abrasion resistant outer PA sheath with acoustic interlocking system	
Gel-Filled Stainless Tube	High molecular gel in the stainless tube, where the fibre cores are located, giving best possible acoustic sensitivity	
Unique Strength & Rodent Protection	High tensile strength and rodent resistance, allows the cable to be buried directly underground without additional protection, what is essential for best possible acoustic sensing	
Attenuation of Fibre at 20°C	1310 nm	≤ 0.36 dB/km
	1550 nm	≤ 0.25 dB/km
Cable Diameter	4.5 mm	
Weight	32 kg/km	
Max Tensile Strength	Installation	1000 N
	Operation	700 N
Min Bending Radius	With Tensile	20 × D mm
	Without Tensile	15 × D mm
Maximum Crush Resistance	600 N/cm	
Operating Temperature	-40 °C ~ 85 °C	
Installation Temperature	-10 °C ~ 50 °C	
Storage Temperature	-40 °C ~ 85 °C	

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