

A Higher Level of Performance



Praetorian Fibre Optic Sensing Perimeter Security & Threat Detection



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A Complete Perimeter Security and Border Control Monitoring System

Praetorian Perimeter Security



Principle of Operation

Using a combination of Rayleigh backscatter and time of flight, Praetorian determines the presence, location, intensity and frequency of vibrations along an optical fibre in real time.

Rayleigh backscatter responds to physical vibrations imparted on the fibre by disturbances to the application. HAWK'S signal analysis software allows Praetorian to quickly determine the most likely origin of the vibration and report any nefarious signals to security personnel without notifying an intruder of their detection.

Location of vibration is determined using a "Time of Flight" calculation. When a laser pulse is emitted from the system a very fast clock is started. As backscattered light returns to the detector they are recorded for further analysis and time stamped. Due to the speed of light being constant within a fibre (approximately two thirds of normal light speed) this time stamp corresponds to a distance on the fibre.

Function

Praetorian acts as an infinite series of microphones within the fibre recording in real time. The system analyses an enormous amount of data using ultra fast FPGA architecture to give real time feedback on the likely origin and type of the disturbance. Utilizing proprietary pattern recognition software Praetorian reduces the incidences of false positives normally associated with other Fibre Optic Sensors.

Praetorian uses a series of pattern recognising modes to detect, identify and report nefarious movements at, on or around the perimeter being monitored.

Multiple outputs are available from simple Alarm/No-Alarm States to full digital integration such as Modbus over Ethernet and can be fed directly into existing DCS and SCADA control systems for high speed integration. Alternatively, Praetorian can be operated directly with a keyboard and mouse through the units inbuilt Human Machine Interface (HMI).

Praetorian's fast processing speed and pulse rate allow it to detect minute interferences that may otherwise go unnoticed. Some examples of detectable activities include:

- Intruder movement along a perimeter
- Intruder movements either side of a perimeter via covert sub terrain detection (Intruders cutting a fence)
- Intruders climbing a fence
- Vehicle movement along a perimeter
- Digging, excavation, trenching and undermining

Praetorian also Geo-tags alarms allowing security or surveillance teams to respond immediately.



Detection of digging / trenching close to fence

Primary Areas of Application

Installation locations:

- Army barracks
- Airports
- Prisons
- Explosive storage areas (Magazines)
- Country borders
- Hazardous areas
- Unmanned sites

Applications:

- Cyclone fence perimeter
- Concrete, block or brick wall perimeters
- Covert subsoil installation
- Sterile zone monitoring
- Gate traffic monitoring
- Boarder protection
- Barbed or concertina wire
- Security patrol tracking



Praetorian Fibre Optic Sensing

Perimeter Security & Threat Detection



How it works

Time of flight

Locations of intrusions are able to be accurately determined by a method called time of flight. The amount of time from sending the laser pulse to receiving a return signal is recorded. Due to the internal properties of a fibre optic core, the speed of light through a fibre is consistent at approximately two thirds of the speed of light through a vacuum (around 400µs for a 40km round trip). As this is consistent, the return time can be used to calculate a distance on the fibre.

Vibration Detection

Detection of vibration is Praetorian's primary sensing method and uses on the amount of vibration energy created by a disturbance to the perimeter (fences, walls, Covert underground fibre etc) at the disturbance's location.

In Praetorian, an optical effect called Rayleigh backscatter is used to observe vibrational effects on a fibre. In a fibre optic core, backscatter is the light that reflects off natural imperfections and polarizations within the fibre and returns to the light source. The return light gets diffracted into different frequencies similar to light moving through a prism and Rayleigh backscatter is one of these diffracted frequencies. The amount of compression that vibration from an intrusion causes on the core determines the strength of the Rayleigh component of the backscatter. In this way the intensity and frequency of the vibration is measurable by recording the behaviors of the Rayleigh backscatter component. This change in intensity and frequency is used to determine the presence and position of an intruder to within on meter.

To being classified as an alarm the amount of time, the dominant frequencies and the relative intensity all need to be present within pre-determined thresholds. This reduces the amount of false signals that make it to alarm state.

Unique Features

No Time Splicing

Praetorian has a number of unique features which make it a market leading technology. Unlike other fibre sensing technologies the field programmable gate array allows for ultra fast parallel processing of the returned signals. Praetorian does not have to time splice or "skip" sections of time to keep up, potentially allowing a chance for an intruder to go unnoticed.

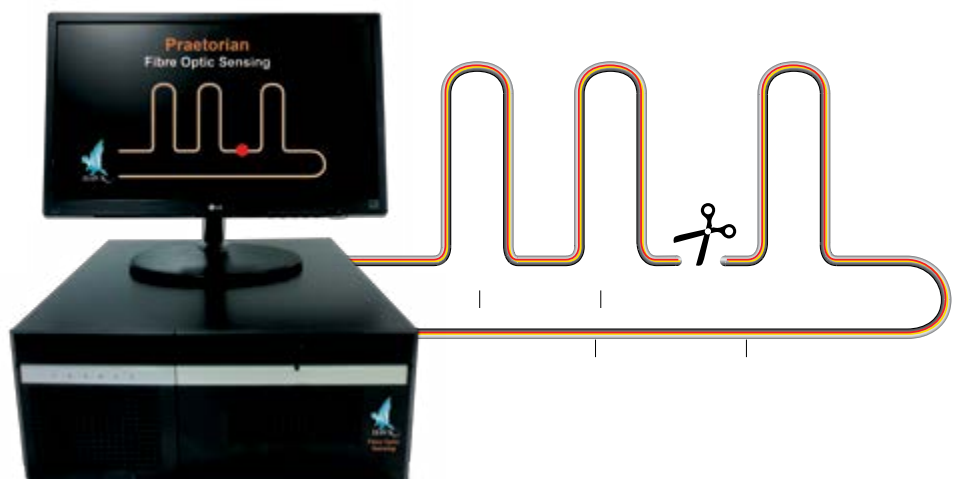
Broken/Cut Cable Immunity

One distinct advantage with the Praetorian system is that it is able to work such that it is immune to the effects of a broken or cut fibre. The unit is able to be attached as a loop to both channels on independent fibres and in the event of a cut will report the damage but continue to monitor the fibre on both sides up to the cut.

No Signal Fading

In all distributed acoustic fibre sensors, the detected signal level has certain variations depending on the polarization state of the received signal which produces scattering of the signal. This scattering can be constructive interference or deconstructive interference and to date there has been no method to control this scattering which is commonly referred to as signal fading.

HAWK has patented an effective solution to overcome signal fading where small signals can be detected without fading.





Unique Features

Extreme Laser Stability

Unlike systems restricted by Multimode LED light sources, Praetorian uses a highly stable laser controlled to within $\pm 5\text{pm}$ allowing the system to handle two independent sensing channels of up to 40km each without any loss of measurement in switching or time splicing.

Fibre Condition Monitoring

Praetorian is also able to monitor cable condition whilst performing its normal duties. The condition of return signal at commissioning is recorded and Praetorian regularly compares current signals to this commissioned state. Praetorian is able to determine that degradation is occurring to the cable due to age or other environmental condition and warn the user well in advance of sensing or

Additional Features

- Standalone Hardware Capable of detecting and generating alarms
- Multi-Sensing Capability - DAS (Acoustic) + DTS (Temperature) + DSS (Strain)
- Multivariable Analysis minimize false positives
- Automatic Signal Calibration
- System Interlock - Optional Laser Shutoff in case of Cable Break
- End of Fiber Detection to ensure Fiber Length
- Real Time Fiber + Connector Quality monitoring
- Dynamic Threshold in 250mm segments
- Temperature Compensation Over full fiber length
- Independent detection algorithms for Static & Motion Tracking Signals
- 64 Bit high speed FPGA Architecture
- GIS Integration Capability
- 48 Point on-board multifunctional self-diagnostic feature
- Adjustable Pulse width from 10ns to 295ns
- Very High Extinction Ratio (More than 80dB)
- Monitors Gate Open/Close activities and Vehicle Movement

Technical Specifications

Category	Parameter	Description
General	Sensing element	Fibre Optic Sensing Cable
	Number of channels	1 or 2
	Interrogator operating temperature	0-50°C
	Unit operating humidity (max)	85% non-condensing
	Dimensions	4RU 19" Rack Enclosure (190x600x490mm)
	Internal Cooling	3 individually controlled fans
	Weight	25kg
	Power supply	110-240VAC (50-60Hz, 24VDC)
	Power consumption	<200W
Performance	Sensing range	Up to 40km per channel
	Spatial resolution	250 or 500mm
	Frequency response	1Hz-120kHz (Range Dependant)
	Temperature sensing range (cable)	-30°C to 200°C (special options for temps up to 800°C and down to -200°C available)
Technical	Light source	Laser (Infra red) Class 1M
	Laser wave length	1550.12nm (nanometres)
	Laser stability	$\pm 5\text{pm}$ (picometers)
	Acquisition rate	400MHz
	Processor transfer rate	64Bit (Ultra high speed)
	Operating system	Linux
	Output	Modbus over Ethernet (Standard) USB
	Remote interfacing	Ethernet, Wi-Fi and 3G/4G enabled
	Processor architecture	Field programmable gate array (FPGA)
	Data storage (Removable)	2x 2TB HDD (removable)
Data storage (Internal)	128GB Solid State Drive	



Primary Uses



Secure zone monitoring

Country borders, military bases, power plants, oil refineries, government facilities, sea ports, airports, jails, etc, all need 24 hr real time monitoring to stop intrusion.



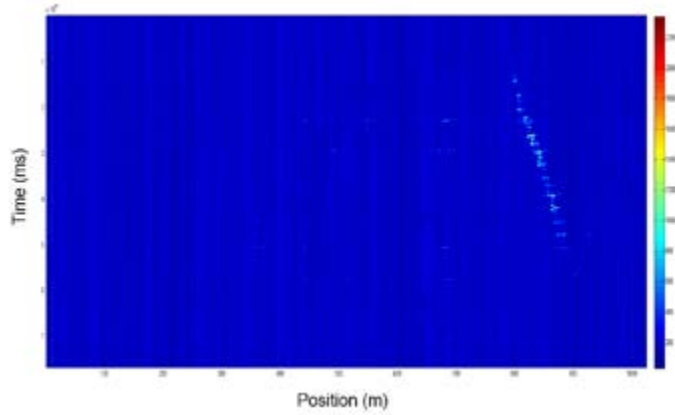
Perimeter security with buried sensing cable

HAWK's Praetorian FOS can detect amplitude, spectrum of vibrations and position of intruders walking or entering a secure zone by using buried fibre optic cable. Praetorian FOS can identify vibration due to weather effects, walking and crawling to reduce incidence of false alarms.



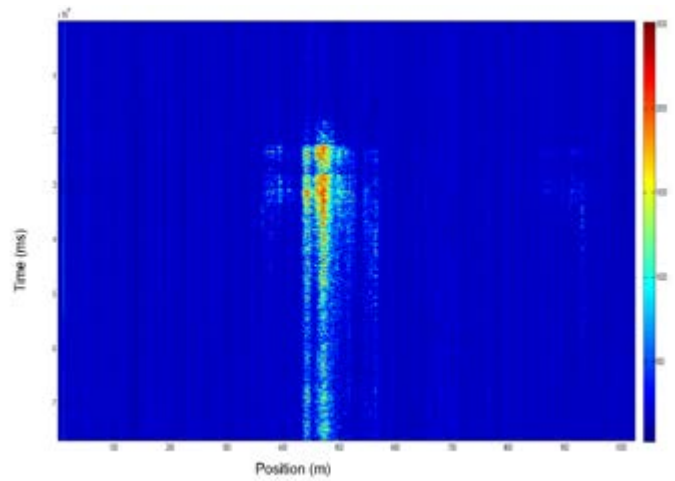


Detection of intruder approaching



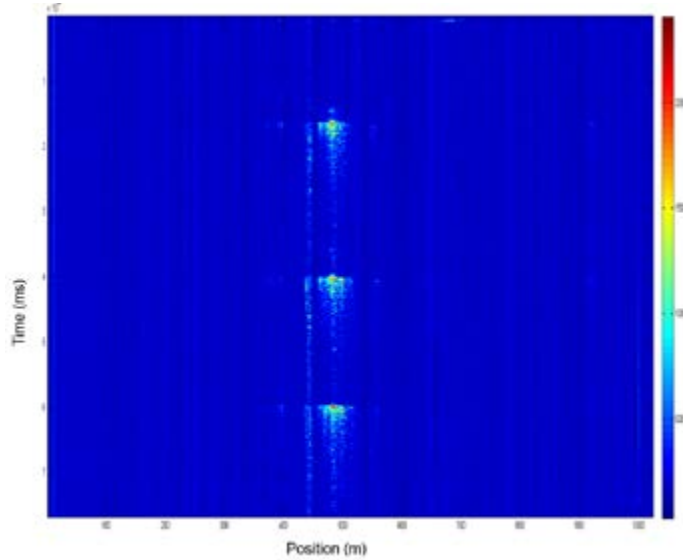
Intruder walking for 35 sec between 800m and 880m positions.
Approx 2.3 m/sec

Detection of climbing on fence



Climb attempt at 470.5m position

Detection of damage to fence



3 cuts at 20 sec intervals at 49.0m



Part Numbering

Model

FOS Praetorian Fibre Optic Sensing Interrogator

Power Supply

B 24VDC

U 110-240VAC

Sensing Method

AXX Distributed Acoustic Sensing

Channel

01 Single Channel

02 Dual Channel

Mounting

4R 4RU Rack Mount

Communications

M Modbus TCP/IP

Software Options

PID Perimeter Intrusion Detection System

Version

X HAWK

FOS U AXX 02 4R M PID X

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