

A Higher Level of Performance



Praetorian Fiber 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, the Praetorian determines the presence, location, intensity and frequency of vibrations along an optical fiber in real time.

Rayleigh backscatter responds to vibrations applied to the fiber. HAWK'S signal analysis software allows the Praetorian to quickly determine the most likely origin of the vibration and report any error signals to security personnel without notifying an intruder of their detection.

The location of the vibration is determined using a "Time of Flight" calculation. When a laser pulse is emitted from the system a fast clock is started. As backscattered light is returned to the detector, it is recorded for further analysis and time stamped. Due to the speed of light being constant within a fiber this time stamp corresponds to a distance on the fiber.

Function

The Praetorian acts like series of microphones within the fiber, recording vibrations in real time. The system analyses an enormous amount of data using FPGA architecture to give real time feedback on the likely origin and type of the disturbance. Utilizing proprietary pattern recognition software, the Praetorian reduces the incidences of false positives normally associated with Fiber Optic Sensors.

The Praetorian uses a series of pattern recognizing modes to detect, identify and report 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. These alarms can be fed directly into existing DCS and SCADA control systems. Alternatively, the Praetorian can be operated directly with a keyboard and mouse, through the unit's inbuilt Human Machine Interface (HMI).

The Praetorian's fast processing speed allows 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 or intruders cutting a fence.
- Intruders climbing a fence
- Vehicle movement along a perimeter
- Digging and excavation

The 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
- Country borders
- Hazardous areas
- Unmanned sites

Applications:

- Fence perimeter
- Concrete, block or brick wall perimeters
- Hidden subsoil installation
- Zone monitoring
- Gate traffic monitoring
- Border protection
- Barbed or concertina wire
- Security patrol tracking





How it works

Time of flight

The locations of intrusions can 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 fiber optic cable, the speed of light through the fiber is around 400µs for a 25 mile (40km) round trip.. As this is consistent, the return time can be used to calculate a distance on the fiber.

Vibration Detection

Detection of vibration is the Praetorian's primary sensing method. It uses vibration energy created by a disturbance to the perimeter, to initiate alarm signals.

In the Praetorian, an optical effect called Rayleigh backscatter is used to observe vibrational effects on a fiber. In a fiber optic cable., backscatter is the light that reflects off natural imperfections within the fiber and returns to the light source. The returned light gets diffracted into different frequencies, and Rayleigh backscatter is one of these diffracted frequencies. The amount of force that vibration causes on the fiber determines the strength of the Rayleigh component of the backscatter. The intensity and frequency of the vibration is determined by recording the behavior of the Rayleigh backscatter component. This change in intensity and frequency is used to determine the presence and position of an intruder to within 3.2 ft. (one 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 and false alarms.

Unique Features

No Time Splicing

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

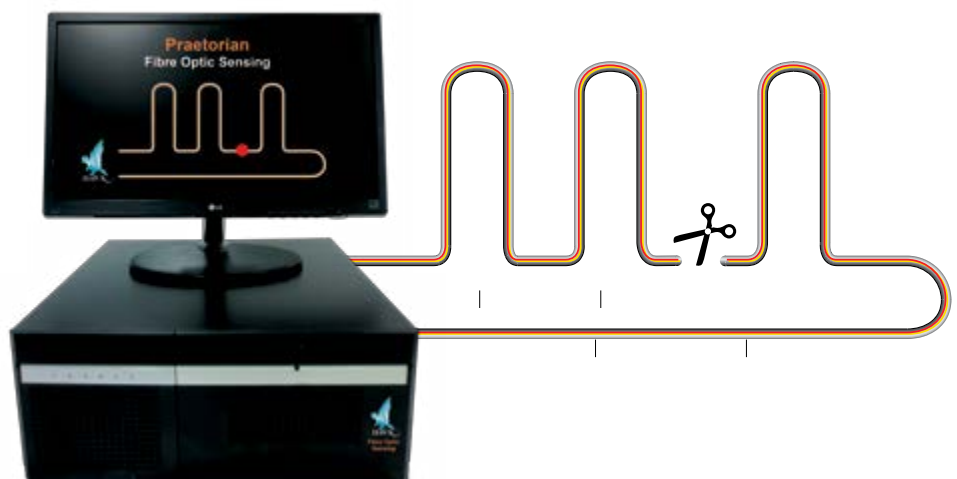
Broken/Cut Cable Immunity

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

No Signal Fading

In all distributed acoustic fiber 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. 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, the 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 25 miles (40km) each without any loss of measurement in switching or time splicing.

Fiber Condition Monitoring

The Praetorian is also able to monitor cable condition while performing its normal duties. The condition of the return signal at commissioning is recorded and Praetorian regularly compares current signals to the commissioned state. The 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 of a failure.

Additional Features

- Stand alone 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 10 inch (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	Fiber 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 7in x 24in 19in (190x600x490mm)
	Internal Cooling	3 individually controlled fans
	Weight	55lbs (25kg)
	Power supply	110-240VAC (50-60Hz, 24VDC)
	Power consumption	<200W
Performance	Sensing range	Up to 25 miles (40km) per channel
	Spatial resolution	10in or 20 in (250 or 500mm)
	Frequency response	1Hz-120kHz (Range Dependent)
	Temperature sensing range (cable)	-22°F to 392°F (-30°C to 200°C)
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	2x 2TB HDD (removable), 128 GB Internal Solid State Drive
	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.



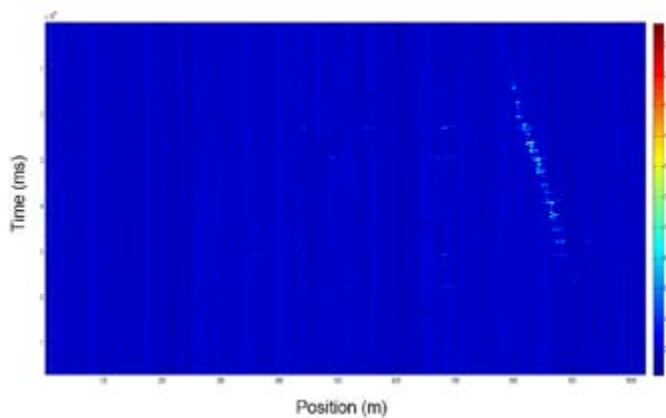
Perimeter security with buried sensing cable

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



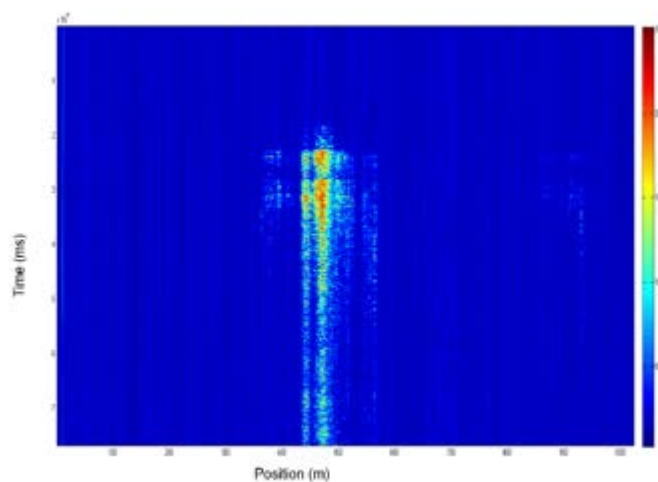


Detection of intruder approaching



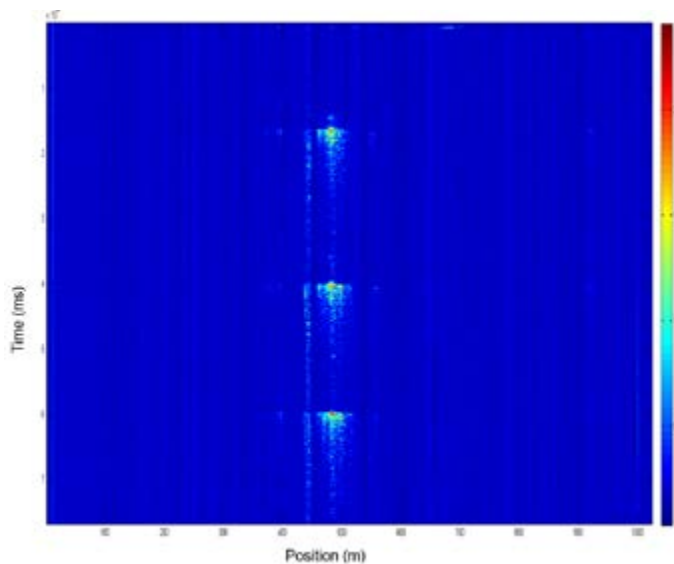
Intruder walking for 35 sec between 2,624 ft and 2,887 ft positions. Approx 7.5 ft/sec.

Detection of climbing on fence



Climb attempt at 1,543 ft position

Detection of damage to fence



3 cuts at 20 sec intervals at 160 ft position



Part Numbering

Model

FOS Praetorian Fiber 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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Technical data subject to change without notice.

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