Microphonic Sensors: Coaxial or magnetic type sensors detect sounds associated with cutting, flexing, sawing or climbing the fence.

Taut-wire: These sensors detect changes to the tension on the fence.

Vibration: Cables are attached to one of more sensor devices which sense vibrations resulting from cutting, flexing, sawing or climbing.

However, current PIDS are susceptible to false alarms. For example, nuisance events such as rain, birds sitting on a fence or seismic vibrations caused by aircraft landing or taking off may raise false alarms.

A need therefore exists to provide a fiber Bragg grating (FBG) sensor structure, a method of fabricating the same, and a method of employing the same that seeks to address at least one of the abovementioned problems.

SUMMARY

In accordance with a first aspect of the present invention, there is provided a fiber Bragg grating (FBG) sensor structure comprising an optical fiber portion having at least one FBG formed therein; and a sleeve structure capable of transferring vibrations and/or strain along a length thereof; wherein the optical fiber portion is disposed inside the sleeve structure and coupled to an inner circumference of the sleeve structure such that the central wavelength of the FBG is variable under the transferred vibrations and/or strain, and wherein one or more portions of the optical fibre portion comprises a collar that is connected to the inner circumference of the sleeve structure.

The optical fiber portion may be coupled to the sleeve structure such that the central wavelength of the FBG may be variable under amplitude and frequency of the transferred vibrations and/or strain.

~~The optical fiber portion may be disposed inside the sleeve structure.~~

~~The optical fiber portion may be coupled to an inner circumference of the sleeve structure.~~

The ends of the optical fiber portion may be connected to the inner circumference of the sleeve structure.

~~One or more portions of the optical fiber portion may comprise a collar, and the one or more collars may be connected to the inner circumference of the sleeve structure.~~

The sleeve structure may comprise a resilient metallic tube.

The sleeve structure may further comprise a protective cover on the resilient metallic tube.

The protective cover may comprise a UV protection material.

The FBG sensor structure may further comprise a buffered fiber portion connected to at least one end of the optical fiber portion.

The buffered fiber portion may extend along the length of the sleeve structure for optical connection of the two optical fiber portion.

Two buffered fiber portions may connect at respective ends of the optical fiber portion.

The sleeve structure may be configured for suspending the optical fiber portion at a sensing location.

The optical fiber portion may comprise a single fiber having an array of FBGs formed therein.

The FBG sensor structure may comprise a plurality of optically interconnected optical fiber portions having respective FBGs formed therein, each optical fiber portion coupled to the sleeve structure such that the central wavelength of each FBG may be variable under the transferred vibrations and/or strain.

The optical fiber portion may comprise a single mode fiber.

The optical fiber portion may further comprise a loose sleeve disposed over the single mode fiber.

The FBG sensor structure may further comprise an interrogator optically connected to the one or more optical fiber portions, the interrogator configured to transmit signals to the one or more optical fiber portions and measure signals reflected from the one or more optical fiber portions.

In accordance with a second aspect of the present invention, there is provided a method of fabricating a FBG sensor structure, the method comprising the steps of providing an optical fiber portion having at least one FBG formed therein; ~~and~~ coupling the optical fiber portion to an inner circumference of a sleeve structure capable of transferring vibrations and/or strain along a length thereof, such that the central wavelength of the FBG is variable under the transferred vibrations and/or strain; attaching one or more portions of the optical fiber portion with a collar; and connecting the collar to the inner circumference of the sleeve structure.

~~The method may further comprise the step of coupling the optical fiber portion to an inner circumference of the sleeve structure.~~

The method may further comprise the step of connecting the ends of the optical fiber portion to the inner circumference of the sleeve structure.

~~The method may further comprise the steps of attaching one or more portions of the optical fiber portion with a collar; and connecting the one or more collars to the inner circumference of the sleeve structure.~~

One optical fiber portion and one sleeve structure may form one sensing element.

The method may further comprise the step of connecting a plurality of sensing elements to form a sensor array.

The optical fiber portion may have an array of FBGs formed therein.

The method may comprise fabricating a plurality of optically interconnected optical fiber portions and feeding said plurality of interconnected optical fiber portions into a single sleeve structure to form a sensor array.

In accordance with a third aspect of the present invention, there is provided a method of employing a FBG sensor structure ~~comprising an optical fiber portion having at least one FBG formed therein~~as set out above; the method comprising detecting wavelength variations of the optical fiber portion under vibrations and/or strain transferred using ~~a~~ the collar that is coupled to the inner circumference of the sleeve structure, and the sleeve structure is coupled to the optical fiber portion.

The method may further comprise the step of suspending the FBG sensor structure between two substantially fixed mounting elements, such that the sleeve structure extends along a structural feature disposed between the mounting elements.

Disturbances experienced by the structural feature may be detected by the sleeve structure as vibrations and/or strain and transferred to the optical fiber portion, resulting in a variation of the central wavelength of the FBG.

The FBG sensor structure may be suspended in a pre-tensioned fashion.

The structural feature may comprise a fence, and the mounting elements may comprise of the fence near the struts of the fence.

The FBG sensor structure may be fixed by way of metal plates connected to the mounting elements.

The FBG structure may be supported in regions between the mounting elements in a manner such as to allow transfer of the vibrations and/or strain using the sleeve structure coupled to the optical fiber portion.

The FBG structure may be supported in the regions using a first securing means to hold the sleeve structure, and a second securing means coupled to the first securing means, the second securing means secured to the structural feature.

BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by