THE OPTIC FIBER INFRASOUND SENSOR

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ABSTRACT

A goal of current infrasound research is to devise systems to maximize the detection capability for signals of interest in the presence of ambient noise in the frequency range of a few millihertz to a few hertz. It has been well demonstrated that the principal source of noise in the requisite frequency band is turbulence in the wind field. To reduce the effects of this noise, we have designed a new type of infrasonic sensor using optical fibers as distributed sensing elements. The design addresses the limitations of the standard pipe filters currently used to average wind-generated, turbulent pressure fluctuations. In addition to maximizing the signal-to-noise ratio, the system has the capability to help estimate signal azimuth and phase velocity.

The principal advantages of the OFIS (optical fiber infrasound sensor) over the standard pipe filter/microbaragraph combination are:

> The OFIS measures the integrated pressure variations along its length, *not* an acoustical sum of the pressure at many points, as is the case for the pipe filter.
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> The speed of light rather than the speed of sound governs the OFIS response. The OFIS response is thus flat across the entire infrasound frequency band. The standard pipe filter response is certainly not flat and is extremely difficult to determine in practice.
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> The OFIS can be made arbitrarily long and deployed in an arbitrary geometry. As its output is the integral of the pressure field along its length, the OFIS is inherently sensitive to signal directivity and can be deployed as a directional array element.

We have assembled a prototype optical fiber infrasound sensor, have performed laboratory evaluations, and have run comparisons of the new sensor with more traditional sensors in the field. Field experiments are conducted at the Infrasound test facility, part of the Cecil and Ida Green Pinon Flat Observatory. This facility includes a variety of infrasound spatial filters and recording systems, including an 8-element infrasound array composed of four 18-m and four 70-m spatial filters. This test bed has proved to be ideal for this kind of research as wind speeds vary from near zero to > 10 m/s.

The development of a new interferometric fringe data acquisition system has been a key component of this effort. We can now construct arbitrarily long lengths of the sensor. The remaining task is to investigate the best deployment geometry for optimizing the sensor as a component in an array.

Key Words: Infrasound
Optical fibers
Spatial filter