*pico*DAS Fiber Optic Distributed Acoustic Sensing System

*pico*DAS is a fiber optic distributed acoustic sensing system (DAS). The following key features make this product a unique tool to produce unmatched acoustic data quality:

- Exceptional sensitivity
- No sensitivity deterioration caused by distance
- Zero cross-sensitivity between sensors
- Very affordable price

Each of the features above is unique and their combination makes picoDAS an ideal choice to fulfill those needs that require high acoustic data quality and may be difficult to meet by other commercial offerings.

1. WHY IS *pico*DAS UNIQUE?

Distributed acoustic sensing or DAS utilizes silica optical fiber to measure acoustic waves along the entire length of such fiber. Traditional DAS works by sending laser pulses from an interrogation instrument into a sensing fiber. A small fraction of the incident laser is backscattered via Rayleigh scattering. By measuring the arrival

time of backscatters at the optical receiver in the interrogator, the location where each backscatter was produced can be determined by optical time domain reflectometry (OTDR). Traditional DAS operates based on the detection of the Rayleigh backscatters. However, traditional DAS suffers from a major fundamental limitation, which is poor acoustic detection sensitivity dictated by the extremely weak backscatters. This problem is caused by two factors.

The first factor is the extremely weak Rayleigh backscatter. For standard singlemode silica fiber, the backscatter strength is -82dB, or 6 parts per billion, for a 1ns laser pulse at 1550nm. The second factor is the fiber loss, which makes the Rayleigh backscatters at the photodetector even weaker as the sensing distance increases. For example, fiber cable in the field typically exhibits 0.5dB/km loss. This means the strength of the signal from 10km becomes one order of magnitude weaker. The weak Rayleigh scattering and fiber loss together make the already rather limited sensitivity further deteriorate with fiber distance from the interrogator. This often causes these systems to fail to generate quantitative acoustic measurements when the distance exceeds 10km. Moreover, these systems have another major limitation resulting from the randomness of the coherent Rayleigh backscatters, which is significant variation in acoustic detection sensitivity from position to position and from time to time.

*pico*DAS completely overcomes these fundamental limitations of traditional DAS by innovations in fiber fabrication, interrogator design and signal processing. This product offers unprecedented sensitivity that does not decline with increasing fiber distance and does not exhibit any cross-sensitivity between sensors.

2. TYPICAL APPLICATIONS

*pico*DAS' unmatched performance significantly advances the state of the art of distributed acoustic sensing and makes it especially attractive for the numerous applications described below, as well as novel applications where sensitivity and sensor consistency are important design factors.

2a. Oil/Gas Downhole Measurements

Acoustic sensing is important in every phase of oil and gas recovery. Some of these measurements include vertical seismic profiling (VSP), fracture monitoring, quasi-static mechanical strain and temperature measurement, micro-seismic event detection and well flow and integrity monitoring. These measurements utilize different frequency domains of DAS signals. They range from high frequencies produced by injection to near-zero frequencies caused by hydrocarbon flow into the well bore in different perf clusters. In all of these measurements, sensitivity and spatial resolution with minimum cross-sensitivity matter immensely.

2b. Pipeline and Perimeter Monitoring

Long pipelines and perimeters of high value assets require real-time monitoring for leak or intrusion detection. Distributed acoustic sensing has been demonstrated to be a rather attractive option and in many cases the only cost effective option. However, an extremely low false alarm rate is essential, which must begin with a DAS system that has features of an exceptionally low and constant noise floor for the entire sensing length. At the same time, many of these applications are also cost sensitive. *pico*DAS has all these features as demanded and offers a perfect choice for a cost effective yet very high performance system solution.

2c. Flow Measurement

picoDAS has been proven to permit fluid flow sensing by measurement of the acosutic waves produced by the flow of fluids in a pipe. The product can be applied to pipes that have different diameters, fluids, flowrates and temperatures. This non-intrusive sensing method offers highly sensitive and accurate real-time measurements simultaneously at multiple locations.

2d. Structural Health Monitoring

Many important civil structures such as bridges, dams and tunnels require real-time monitoring of their health and operating conditions. DAS can provide rich information about the health condition of these structures. A DAS can be especially useful if it can be engineered to provide a sufficient sensitivity with a broadband response for detection of ultrasonic waves emitted by crack initiations, which have been concluded to be perhaps the only reliable early warning of a structure collapse.

*pcio*DAS is a perfect fit for the applications above. Having clean data for every moment and every location is also important to significantly reduce the demand for data storage. Therefore, the cost effective *pico*DAS equipment plus the savings in the data storage system allow operators to achieve their goals with reduced capital investment.

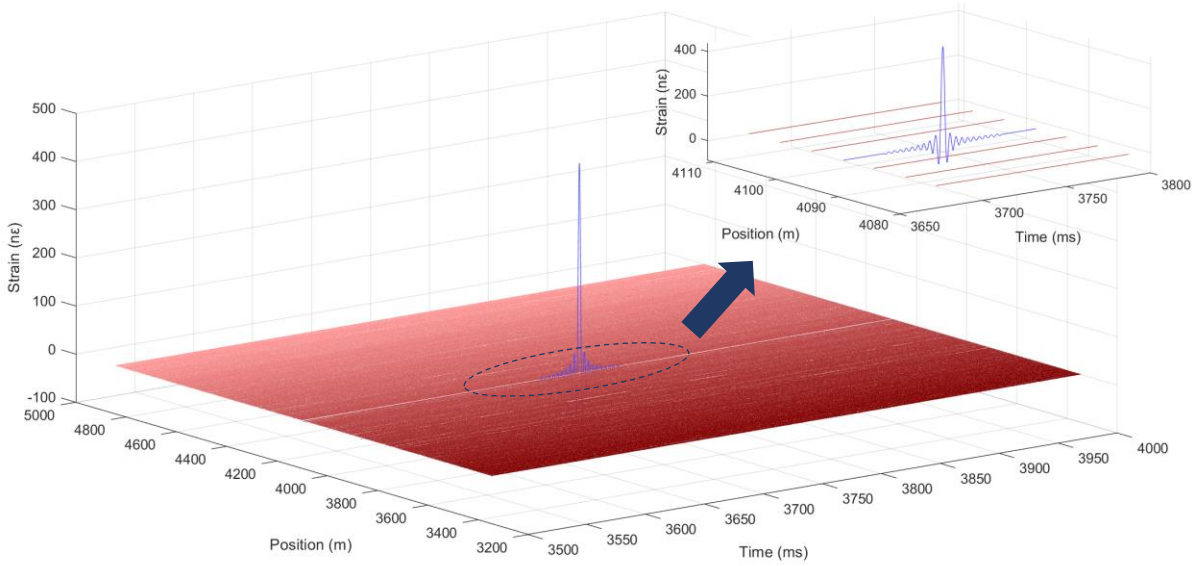
3. SPECIFICATIONS

Model	*pico*DAS			
Spatial Resolution	2m	5m	19m	35m
Sensing Range	≤2km	≤5km	≤10km	≤20km*
Sampling Rate	36-125kHz	15kHz	5kHz	3kHz
Sensitivity	$\leq 0.2n\epsilon$			
Sensitivity Disparity	<20%			
Interrogator Dimensions and Weight	27x45x44cm, 17.3kg			
Computer Interface	Ethernet			
Power	240/110V, 50/60Hz			
Power Consumption	86W Max			
Operating Temperature	0 to 45°C			
Humidity	5-95%			
Fiber Connector	FC/APC or SC/APC			

* Longer distance available on request

4. SPECIAL SOFTWARE FEATURES

PicoDAS system is equipped with powerful software that offers real-time 3-D display of acoustic wave at each position of the sensing fiber. The 3-D graph can be freely rotated and adjusted in display scales. Baseline data storage can be synchronized by external trigger or set by a predetermined threshold of the acoustic amplitude. The software can also display real-time distributed temperature variations along the entire sensing fiber and can provide various post signal processing and analysis. Additionally, data can be downsampled after filtering to significantly decrease storage demands while avoiding inadvertently aliasing noise into the frequency range of interest. This gives the noise-reducing capabilities of a high sampling frequency combined with the data size of a low sampling frequency.



The graph shows real measurement data from a 5km sensing fiber that is interrogated by a picoDAS interrogator with 5m spatial resolution. The red color 'carpet' like plane comprises 360 sensor output lines as part of the 1,000 outputs. All these lines exhibit nearly identical noise floors within ±20% around the mean value ($0.16n\epsilon$). A 4.95m fiber segment at 4.2km position is wrapped on a piezoelectric cylinder which is driven by a function generator to produce an impulse stretch to the fiber. The output of this fiber segment is given in the blue trace, which demonstrates high frequency and high fidelity response with no cross-sensitivity from the neighboring sensing fibers.

5. ORDERING INFORMATION

To Contact
Sentek Instrument LLC
1750 Kraft Drive, Suite 1125
Blacksburg, Virginia 24060, USA
info@sentekinstrument.com
Tel: 540-831-9693

To Order:
Please send your quote request to sales@sentekinstrument.com and specify your requirements on the spatial resolution and sensing distance.