FBGS

Tailored Fiber Optic Sensing
Components & Solutions

FBG sensing in structural health monitoring
"closing the gap"

07.11.2022

We are

a developer and manufacturer of fiber optic sensor components and fiber optic sensor solutions

We are vertical from raw materials to software

We do

Temperature sensing

Shape sensing

Strain sensing

Force sensing

Pressure sensing

For

Medical

Process Industry

Civil engineering

Transportation

Energy

FBGS China (Suzhou)
Sales and applications
(Chinese customers)

FBGS North America (Montreal)
Sales and applications
(North American market)

FBGS Belgium (Geel)
Sales and applications
Development and assembly of measurement systems (interrogators)
Sensing Solution Engineering and R&D Work

FBGS Germany (Jena)
Company Headquarter
DTG® and FSG® production
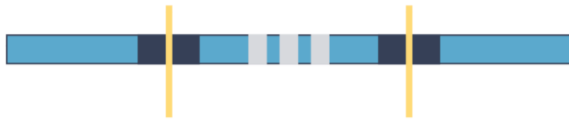R&D location for special fibers and FBGs

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Classical FBG sensing in SHM

Sensing point

Single point sensing

One sensing point in the fiber

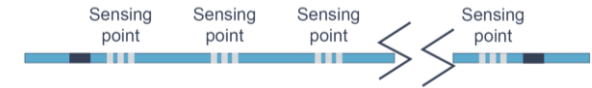e.g. strain sensor or displacement or temperature, etc.

Sensing lengths: few **m to ~10m**

Multipoint

From 2 to 10 sensing points in the fiber

e.g. strain chain or temperature chain, etc.
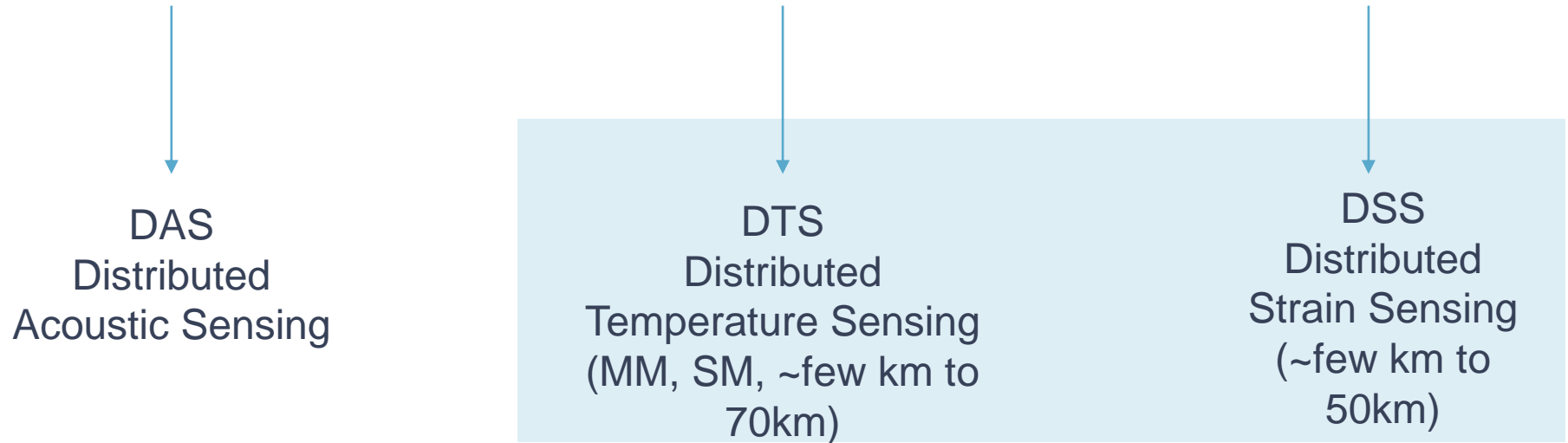
Sensing lengths: few **10´s m to ~100m**

Quasi distributed

From 10 to 50 sensing points in the fiber

Strain cable or temperature cable, etc.

Sensing lengths: few **10´s m to ~500 m max.**

FBGS

Distributed sensing

DAS
Distributed
Acoustic Sensing

DTS
Distributed
Temperature Sensing
(MM, SM, ~few km to
70km)

DSS
Distributed
Strain Sensing
(~few km to
50km)

Based on Rayleigh, Brillouin & Raman scattering
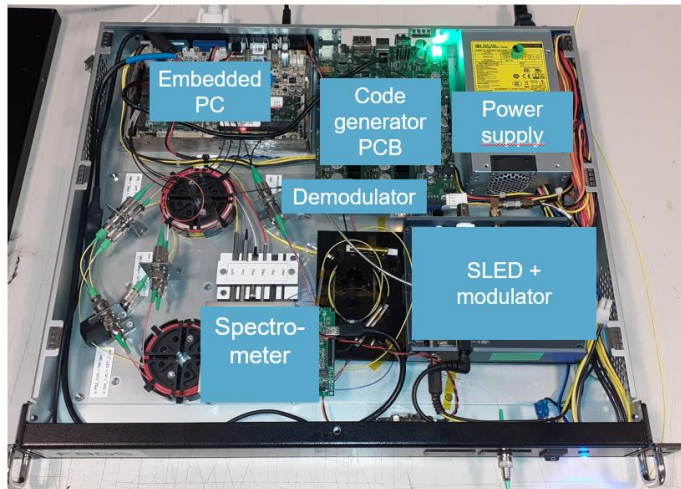Optical time-domain reflectometry or optical frequency-domain reflectometry

Gap between classic FBG sensing and distributed sensing technologies for sensing system between **0.5km** and maybe **5-10** kilometers

"Code Division Multiplexing" based WDM interrogation (CDM-WDM)

Working Principle

- Spectrometer based WDM interrogation sheme + "smart" light modulation enable that multiple WDM section can be combined in one fiber and individually addressed

- **>2000** sensors in one fiber possible
- Measurement speed depending on the number of repeating WDM sections
- Advantage to classical TDM always 50% of the light used

Patent granted - WO2020/070293

Code Division Multiplexing" based WDM interrogation (CDM-WDM)
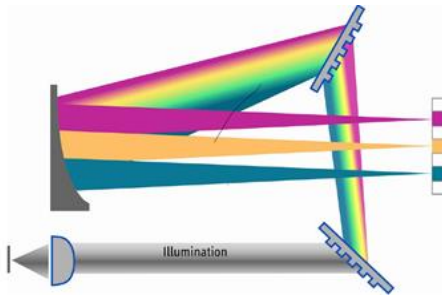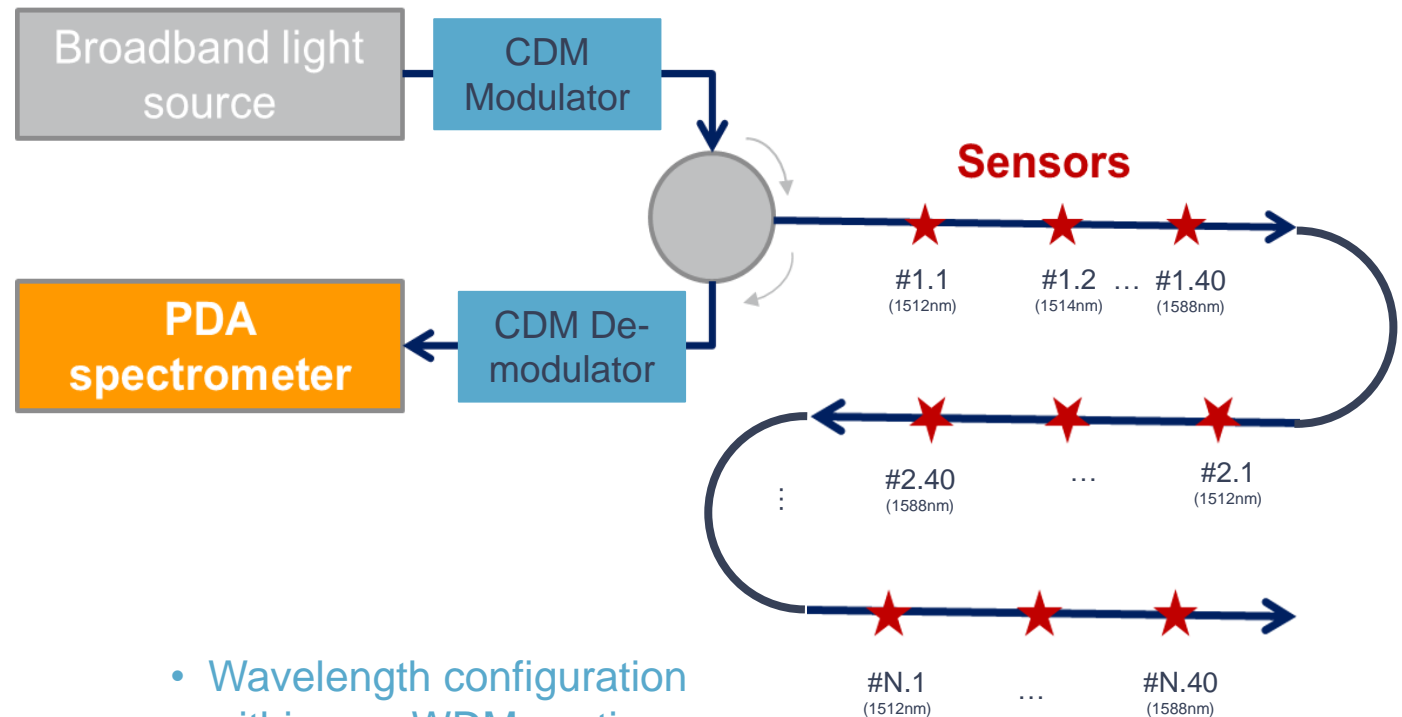
- Wavelength configuration within one WDM section freely selectable
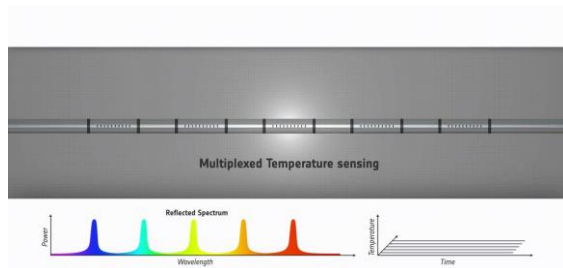- Each DTG is individually addressable (no overlapping spectra)
- Up to 40 sections with up to 50 sensors per section

Temperature test on fiber spool with 1889 FBGs
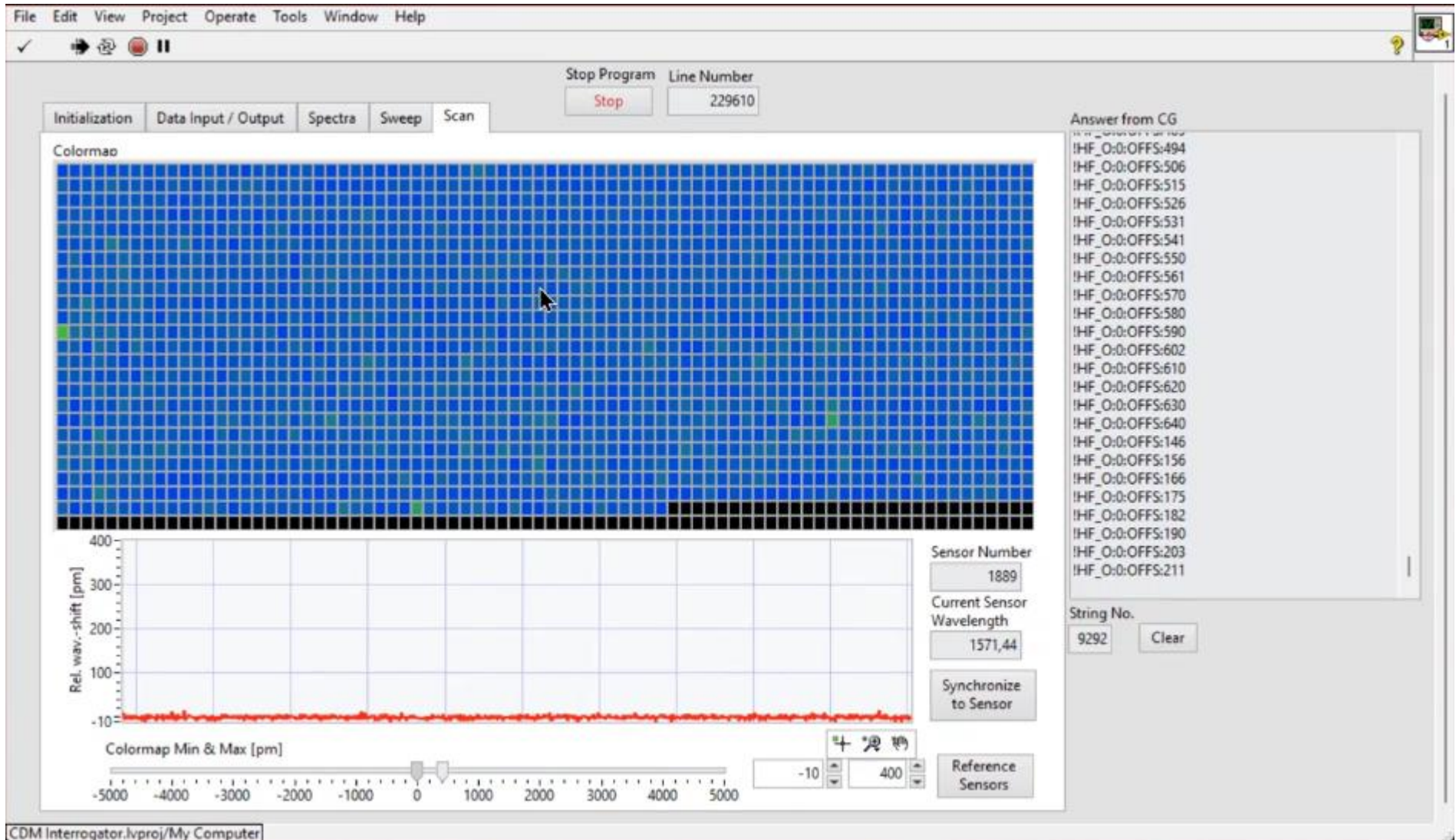
Recording – Tapping one sensor "1879"
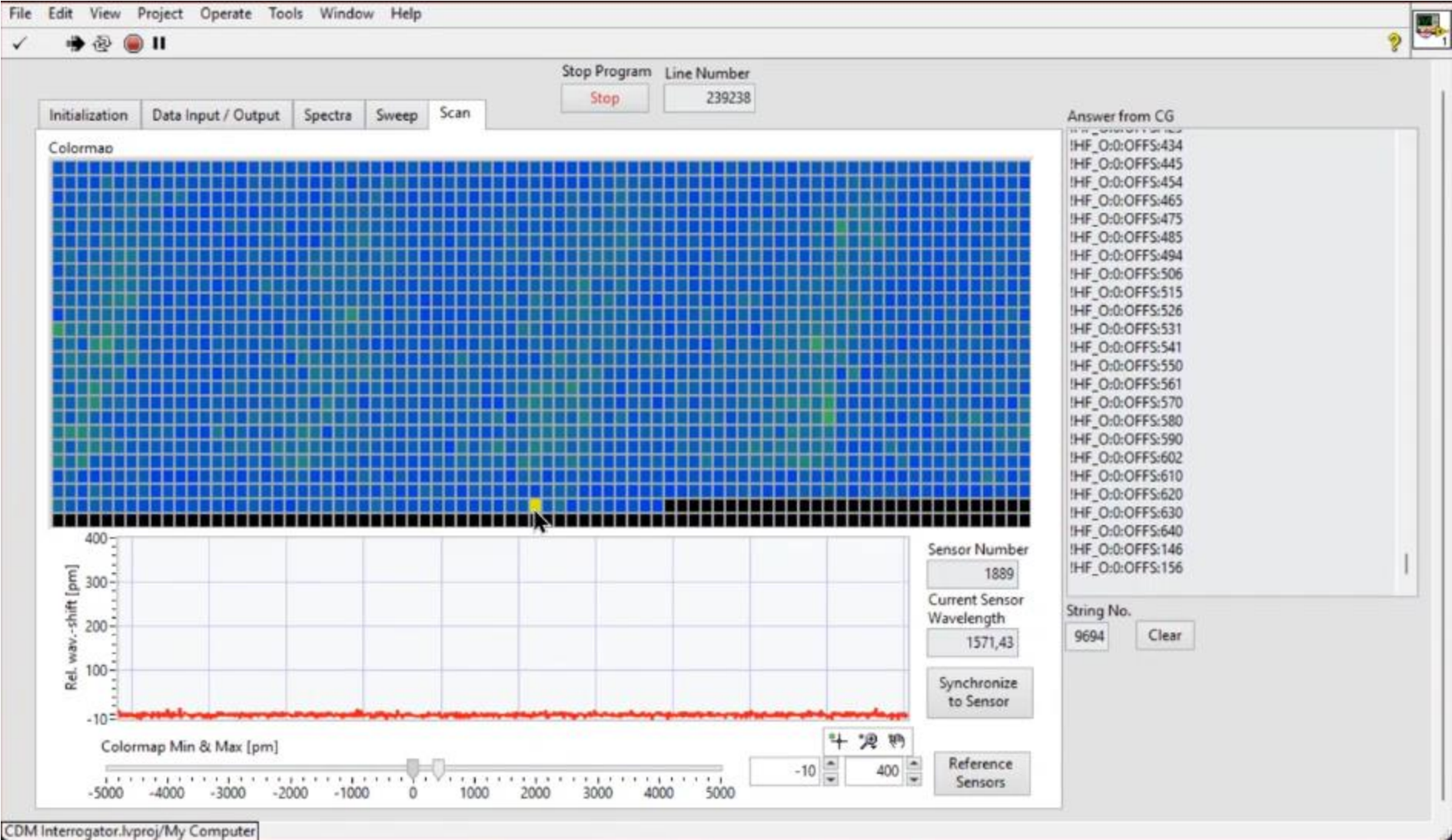
FBGS INFINITY-SCAN

Combining the best of both distributed and quasi distributed sensing using multiple 1000's of FBGs

Measurement device closes gap / market need for monitoring lengths from 0.5km to 5 or even 10 km

Answers market needs with:
. > 2000 FBGs in one fiber possibe
. Sensor spacing from 4cm to 10's m
. Sensor lengths from 50m to 5km (longer on request)
. Measurement speed for big networks >20Hz for 2000 sensors
. Single WDM section measurement speed up to 1kHz
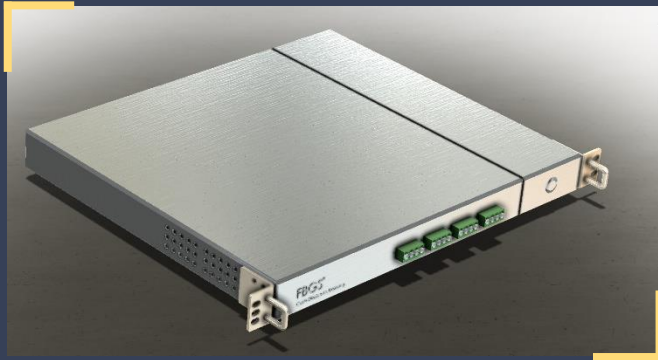
Preliminary design

Parameters

Parameters	FBGS INFINITY-SCAN
Total number of sensors	2 000
Maximum number of WDM-sections	25
Sensor length range	25 m > 1 000 m
Minimum distance between WDM-sections	1 m
Wavelength range	1 510 nm – 1 590 nm
Wavelength precision (1s)	± 3 pm
Wavelength linearity	10 pm
Absolute wavelength accuracy	40 pm
Minimum wavelength spacing	0.8 nm
Dynamic range	>30 dB (user selectable control)
Maximum sampling rate (all sections)	20-50Hz at 2000 sensors (single section 1kHz)
Degree of polarization at the output	< 5%
Optical connector	LC / APC
Laser class (IEC 60825-1)	1

↓ **Parameters are preliminary and subject to changes**

Application fields

Civil engineering

. Dam monitoring

. Roads & bridges monitoring

. Measurment in mines and tunnels

. Intrusion detection

. Perimeter security

Process industry

. Fire detection (tunnels, mines)

. Temperature sensing

. Liquid level sensing

. Leak detection

Energy

. Oil & gas pipeline monitoring

. Hydrogen tank monitoring

. Partial discharge in power cables

. Flexible pipelines

. Energy infrastructure monitoring

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