FBGS
Tailored Fiber Optic Sensing
Components & Solutions

Fiber optic shape sensing

Making the invisible tangible in critical applications.

Combining issues such as reduced exposure to radiations while still being able to “see” through the body may at first seem quite challenging. This was the reason why fiber optic shape sensing was developed. It presents the advantage of being able to track itself thus recreating the shape inside the body.

Fiber optic shape sensing has an outstanding capability to sense curvature and shape in 2D and 3D. The technology will enable cutting-edge applications in the fields of robotic and standard minimally invasive surgery – such as real-time position tracking, instrument and catheter navigation, force and bending detection as well as deformation monitoring.

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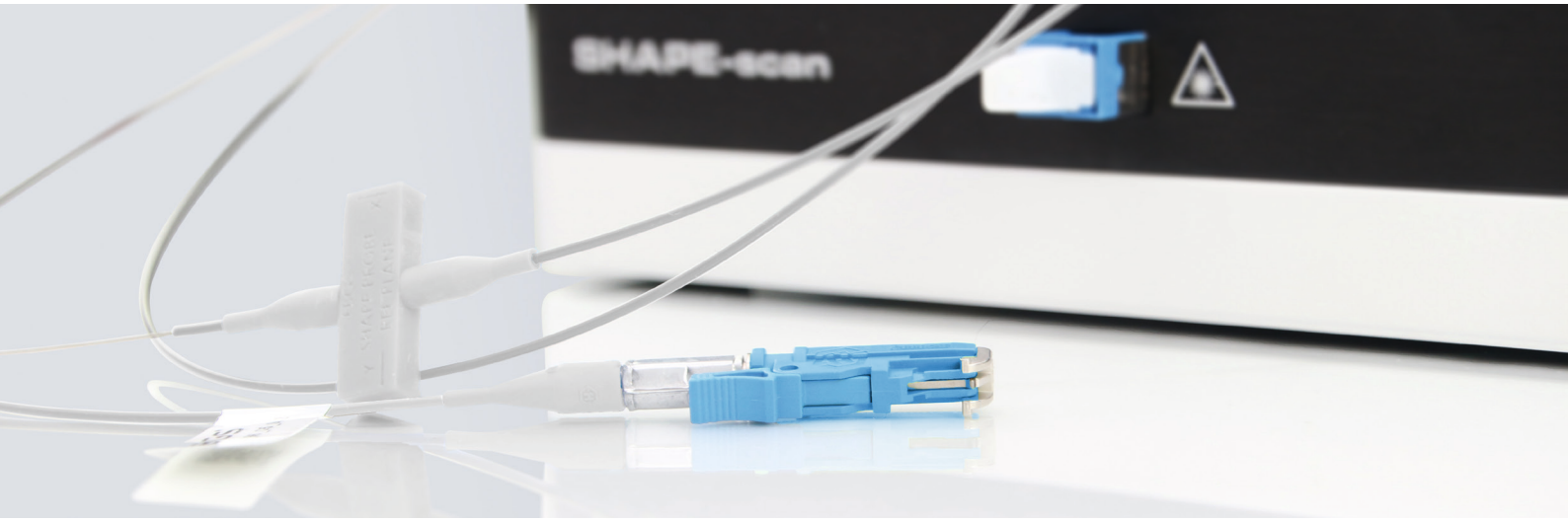
Fiber optic shape sensing as turn-key solution



Components

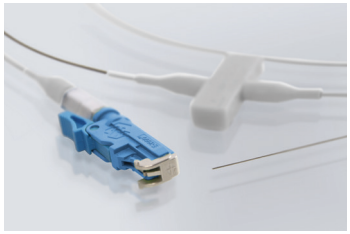
Our fiber optic shape sensing system comprises a sensor, a measurement device and the software that manages all the algorithms for data readout and processing.

→ Shape Scan: Measurement device

→ Shape Probe: Fiber optic sensor

→ Shape Sensing software

FBGS is offering off the shelf shape sensing systems, a customized solution development and support in product integration as well as product manufacturing.



↓ FBGS Shape Scan & Shape Probe

System features

- Turn-key shape sensing system (full system with individual building blocks tailored to application's needs)
- Easy integration in existing systems (Small dimensions of the optical fiber of 0.4 mm, measurement device available on "integrable bracket design"
- High bending detection range (bending radius ≥ 10 mm)
- High strain resistivity suited for challenging applications
- Solution tailored to customers' needs / requirements
- Immune to electromagnetic radiation, passive components
- Miniaturized & biocompatible
- High resolution and accurate shape sensing
- High density of sensors in a single fiber
- Real-time & dynamic sensing

Applications in the medical field

The biomedical sector is currently the main integrator of fiber optic shape sensing systems. It has already found many disciplines mostly in catheter navigation and position tracking. But although shape sensing finds most of its applications there, other fields are not to be put aside. Great potential is also to be found in the energy sector as well as in other industries and R&D.

Here are a few examples, where fiber optic shape sensing can be integrated

- Catheter navigation during ablation procedures
- Tip force detection during ablation
- Navigation for drug delivery catheters
- Robotic instruments force detection and haptic feedback
- Position tracking for manual and robotic orthopedic procedures
- Force sensing for continuum robotic systems
- Shape sensing in continuum robotic systems
- Neurosurgical needle tracking
- Neuro-implant position tracking
- Instrument navigation during bronchoscopy

The key constituent for this type of sensing is based on simultaneous and real-time monitoring of the induced strain in a multi-core optical fiber with included draw tower grating sensors (MCF-DTG®) while compensating for common mode effects such as temperature changes. Depending on the curvature orientation of the MCF, some of the DTG®s on the outer cores will experience a relative tension or compression with respect to the central core and therefore, will register positive- or negative-induced strain changes, respectively. To calculate the local curvature (or bending radius), the relative strains are measured and processed. To determine the curvature profile of an MCF, the gathered data is given as a function of the DTG® positions along the optical fiber and is processed with special reconstruction algorithms.

Parameter	FBGS ShapeScan	
	901	902
	Optical	
Number of shape probes	1	2
Sampling rate	200 Hz	100 Hz
Degree of polarization light source	≤ 5 %	
Optical connector	E2000 / PC	
Laser class (IEC 60825-1)	1	
	Electrical	
Communication	USB	
Power supply	9 - 15 V DC	
Power consumption	≤ 10 W	
External trigger	≤ 5 V DC; via SMA connector	
	Environmental	
Operating temperature	0 to 45°C	
Operating humidity	0% to 80% RH, non-condensing	
	Mechanical	
Weight	2,4 kg	
Dimensions (W x D x H)	250 x 180 x 60 mm	

Parameter	FBGS ShapeProbe
Connector	LSH PC polished (E2000)
Handle dimensions	24 x 8 x 6 mm (W x D x H)
Tube material	Nitinol
Tube outer diameter	0.4 mm
Tube tip	Closed
Operation temperature	15 - 50 °C
XY plan	Defined by handle
Bending radius	≥ 10 mm

* according to Shape Probe configuration

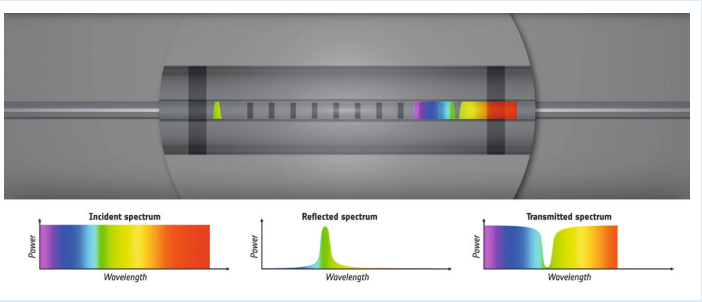
Shape sensing technology

FBG principle

Fiber Bragg Gratings (FBGs) are made by lateral exposure of an optical fiber to a periodic pattern of intense laser light. The generated pattern is translated into a permanent refractive index change inside the fiber core forming a grating.

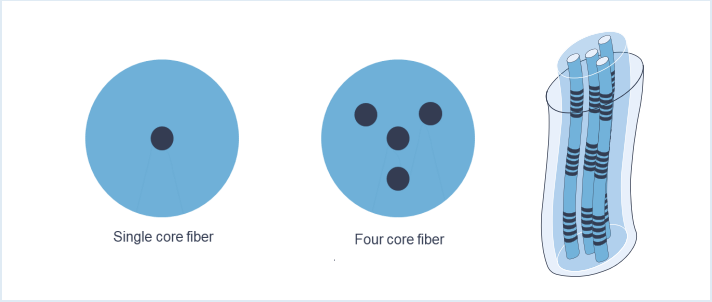
The resulting FBG acts as a wavelength selective mirror for one distinct wavelength (Bragg wavelength). By exposing a fiber with several FBGs to broadband light, each grating reflects a certain amount of light at a different Bragg wavelength which can be spectrally detected.

If the FBG fiber is manipulated by variations of strain and temperature a shift of the Bragg wavelength is measured, which can be used to calculate strain and temperature values very accurately.



Multicore Fiber DTG®s

MCFs are specially configured optical fibers with multiple single-mode cores sharing the same cladding. The cores can all be addressed individually. The DTG® fabrication process has successfully been adopted for writing Fiber Bragg Gratings (FBGs) into the MCFs. Hence, one can simultaneously produce DTG®s of specific configurations in up to 7 cores at the same exact axial location and with the same wavelength. This precision in the inscription of these high density DTG®s in the MCF represents a major advantage.



Any questions?

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ABOUT FBGS

FBGS is a Germany / Belgium based developer and manufacturer of high strength Fiber Bragg Gratings (FBGs), Interrogators, Sensors and custom-made fiber optic sensing solutions. FBGS has developed two unique and fully automated production processes for FBGs which result in very high quality and cost-effective sensing components with unique optical and mechanical characteristics. FBGS's products are suitable for both standard and bespoke applications in industries such as: medical, composite, transport, process, civil & geo, telecom and R&D. FBGS supplies "Draw Tower Gratings" – DTG® and "FemtoSecond Gratings" – FSG® as an OEM component to our worldwide customers. Furthermore FBGS is also developing and manufacturing customized sensing solutions for selected markets.