

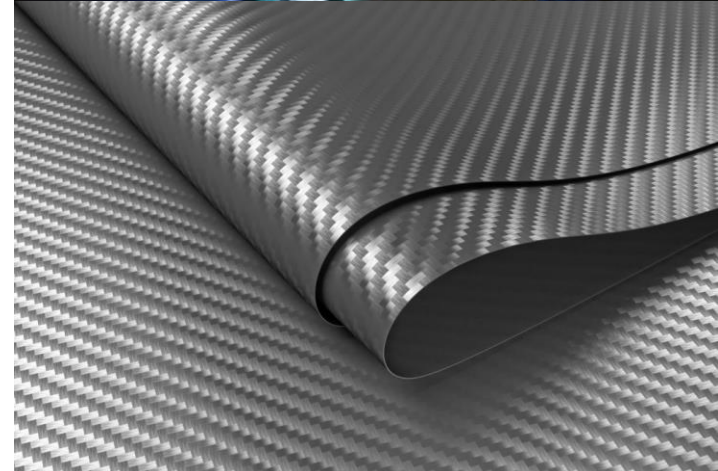


Tailored Fiber Optic Sensing
Components & Solutions

Fiber optic shape sensing – a paradigm shift in medical applications



EPIC Members New Product
Release (November 2020)



FBGS is a Germany/Belgium based developer and manufacturer of high quality Fiber Bragg Grating products and tailored fiber optic sensing components & solutions

FBGS Germany (HQ)



- Company Headquarter
- DTG® and FSG® production
- R&D location for special fibers and FBGs



Jena, Germany
Geel, Belgium
Suzhou, China
Montreal, Canada

FBGS Belgium



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

FBGS China (Suzhou)



- Sales and applications

Industries

Components



Draw Tower Gratings (DTG)



All Grating Fibers (AGF)



FemtoSecond Grating (FSG)



Measurement Devices



Sensors

Energy

Strain, temperature, pressure and shape sensing in flexible risers, pipelines and turbines.



Transportation

Structural monitoring and fire protection in aircrafts, axle counting in ground transportation.



R&D

Investigations during product design and development with fiber optics sensors.



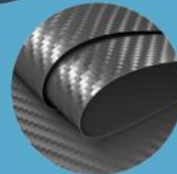
Infrastructure

Asphalt, bridge, dam and concrete monitoring using fiber optic sensors.



Process Industry

Temperature sensing in steel casting molds and distillation towers.



Composite

Strain and temperature sensing with embedded and surface mounted fibers.

FBGS

Tailored Fiber Optic Sensing
Components & Solutions

Solutions



Force Sensing



Shape Sensing



Temperature Sensing



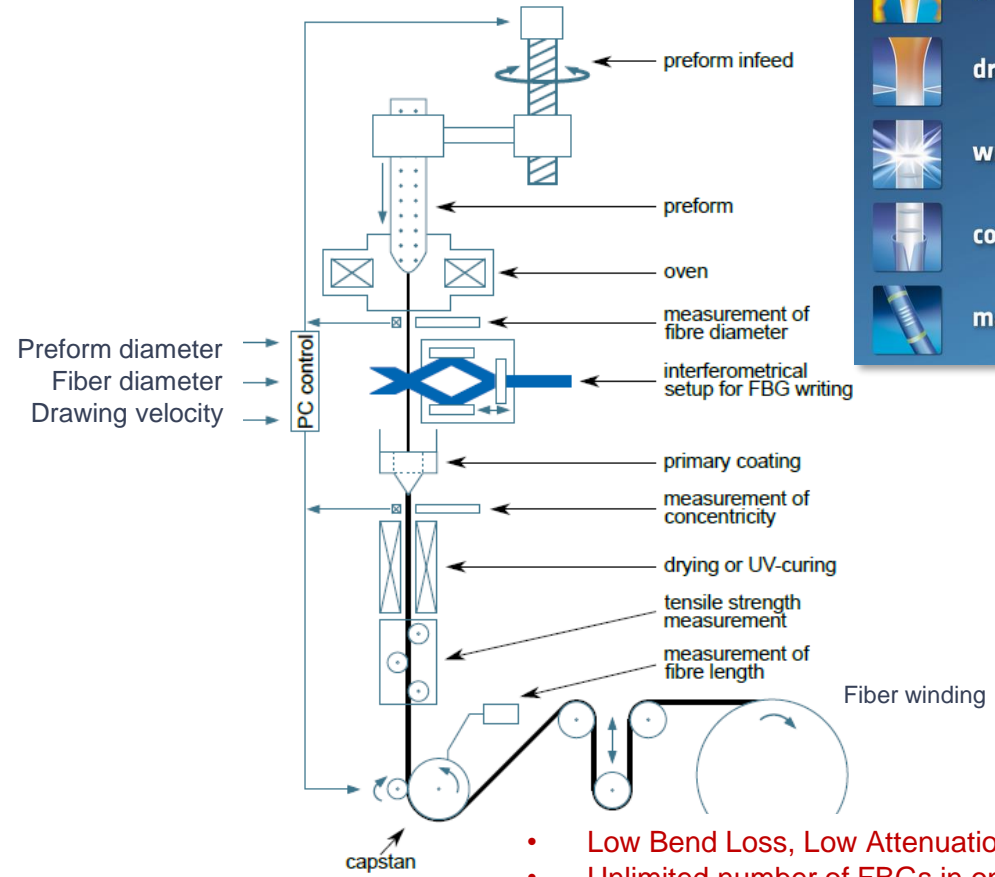
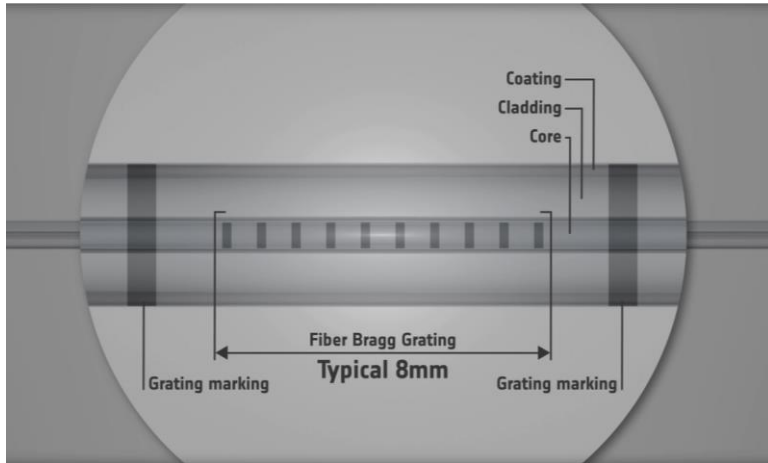
Pressure Sensing



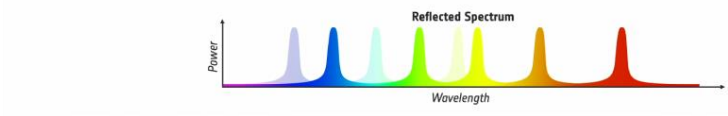
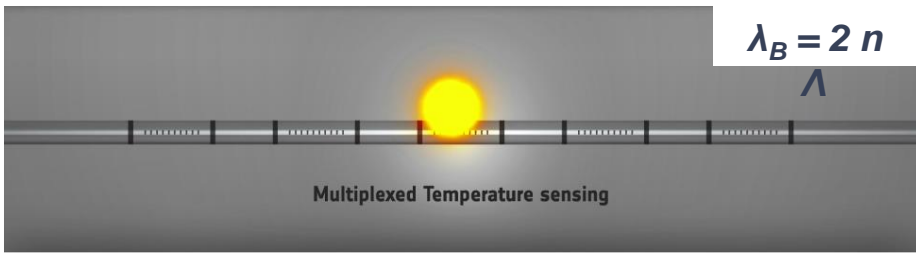
Strain Sensing

Fiber Bragg Gratings – Draw Tower Gratings

Permanent periodic modulation of the refractive index in the fiber core

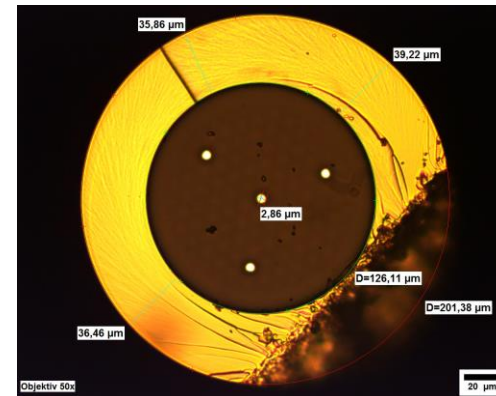
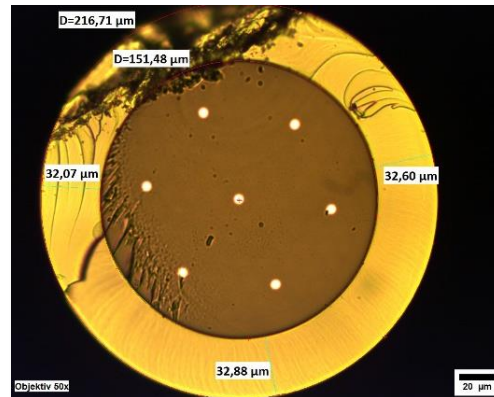
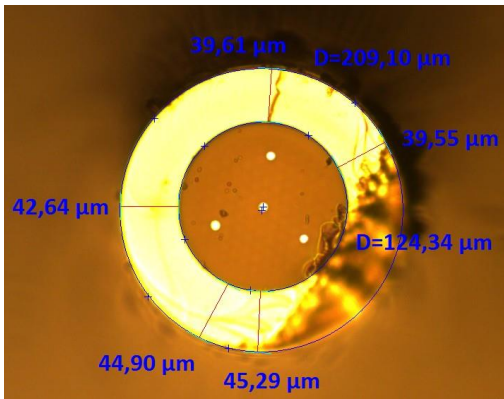
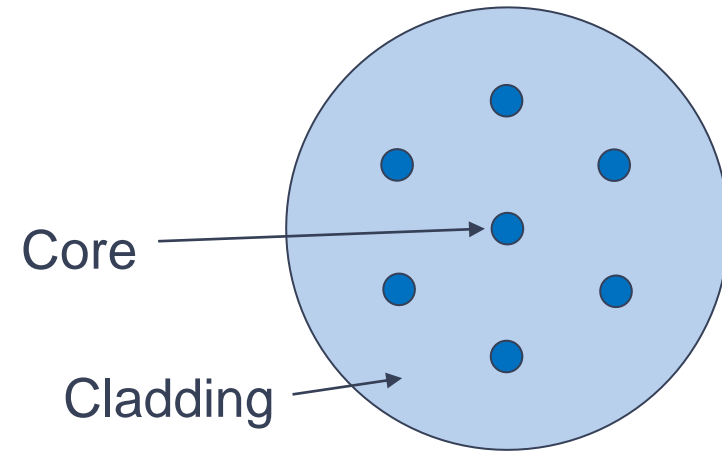
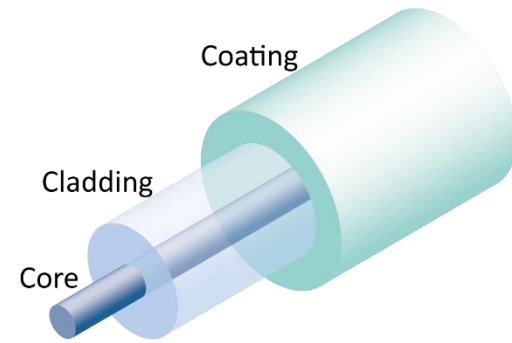


- Low Bend Loss, Low Attenuation
- Unlimited number of FBGs in one fiber



MultiCore Fibers - MCF

- Typical configuration: different outer cores and one central core
- Cladding Outer Diameter: 125 μ m
- Ormocer-T coating enhancing sensor response, enabling fiber handling and connectorization
- Combination with Draw Tower Grating technology
 - Avoiding fiber bundling, core-to-core inscription, etc.
 - Minimal influence of inscription process on fiber strength



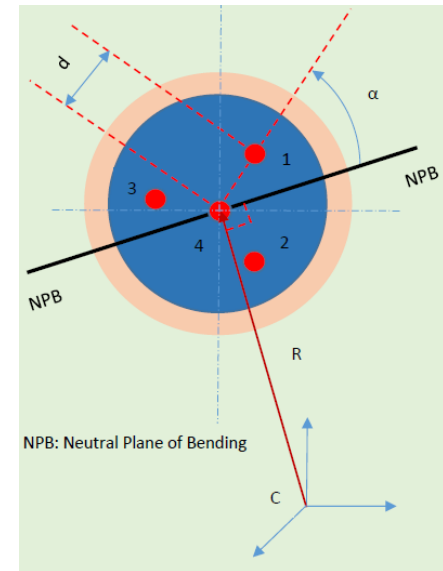
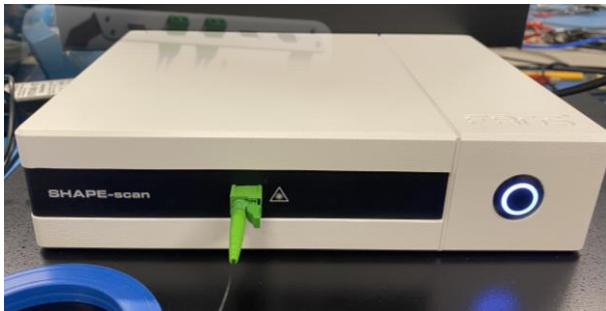
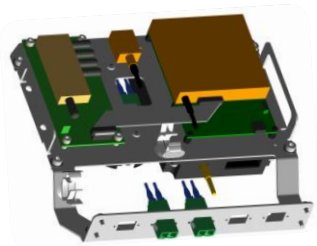
FBGS shape sensing product release

System features

- Turn-key shape sensing system (full system with individual building blocks tailored to application's needs)
- Easy integration in existing systems (fiber OD: 0.2mm)
- High bending detection range
- Solution tailored to customers' needs / requirements
- High resolution and accurate 3D shape sensing
- High density of sensors in a single fiber
- Real-time & dynamic sensing

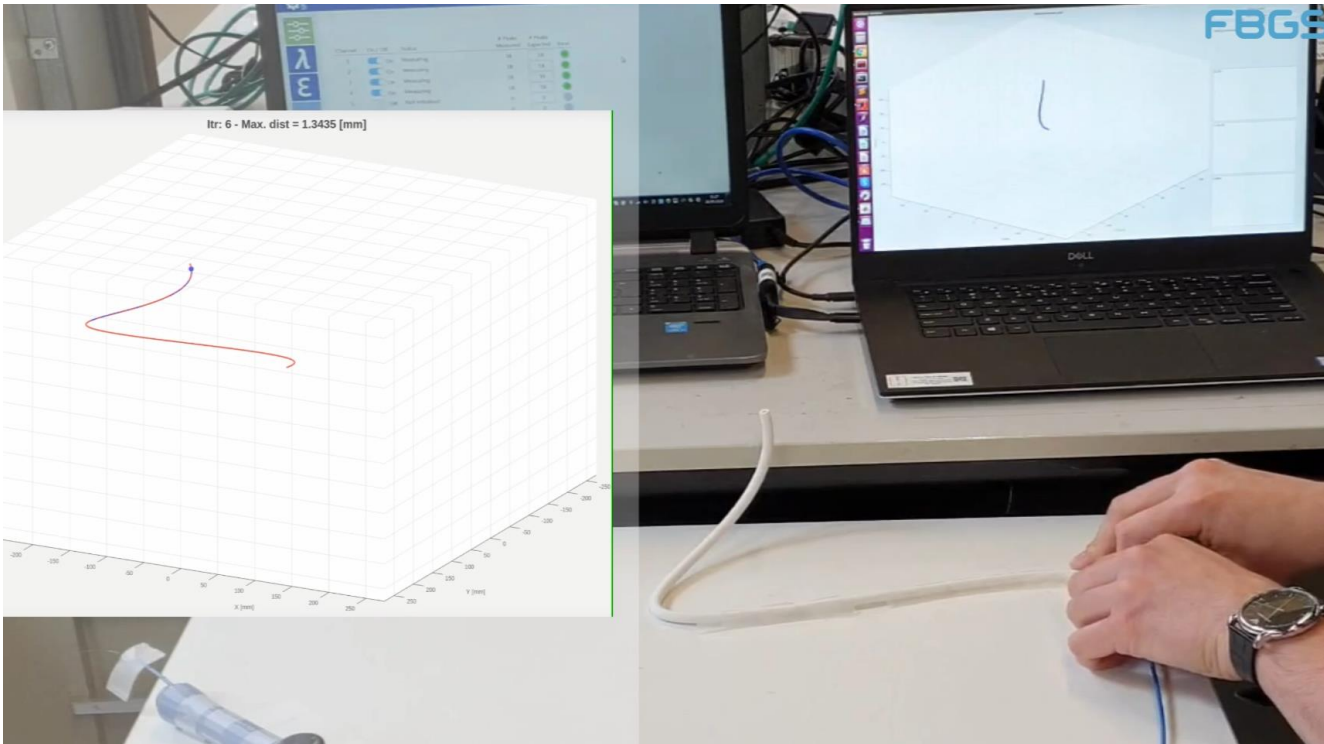
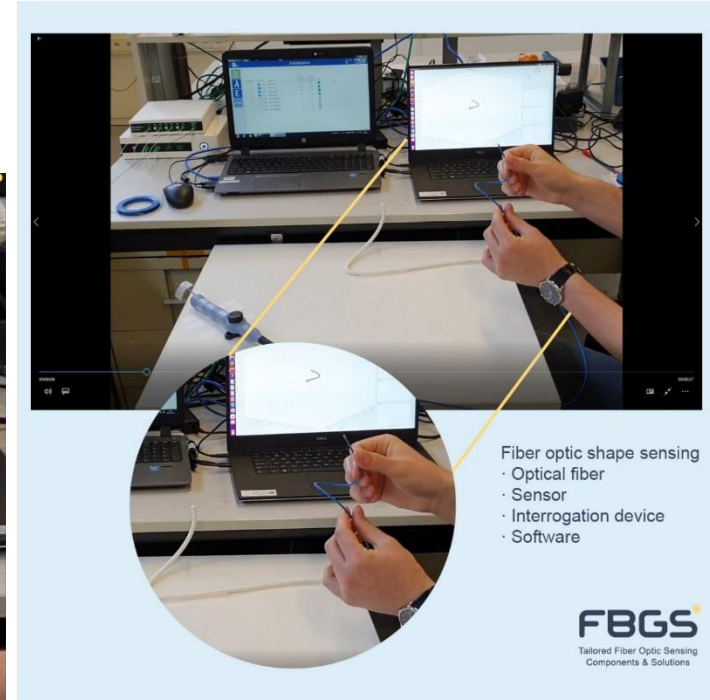
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Shape Sensing System

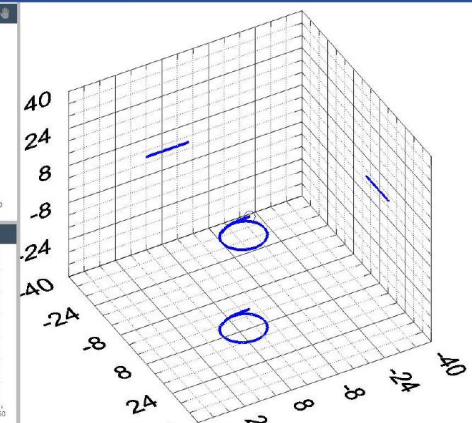


FBGS shape sensing product release

Shape reconstruction and position tracking



Shape Sensing Main **FBGS**



FBGS shape sensing product release

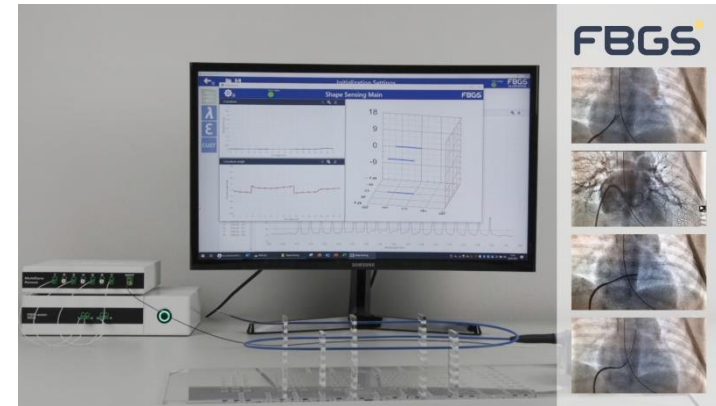
- FBGS' solution
 - unique combination of fully passive and unobtrusive MultiCore Fiber technology and fiber Bragg gratings
 - Precise and real-time position tracking and navigation of medical tools, catheters etc.
- Key application: Navigating surgical instruments in and on the human body
 - Availability and accuracy of existing tracking tools is limited.
 - Existing solutions come with health risks both for patients, physicians and supporting staff due to radiation exposure and the use of contrast agents.
- Enabling more effective surgical procedures which are shorter in time, more precise and which will result in higher success rates while minimizing the risk for patients and physicians.
- FBGS' fiber products come with an unprecedented mechanical strength and a proprietary coating making them ideally suited for medical applications involving dedicated assembly steps, sterilization etc.
- Additional sensing information such as distributed temperature and pressure can be extracted from the same sensing fiber “nerve”

FBGS shape sensing product release

FBGS shape sensing webpage launched today
<https://fbgs.com/solutions/shape-sensing/>

Applications

- 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



FBGS shape sensing solution - Recently published results

- O. Al-Ahmad, M. Ourak, J. Van Roosbroeck, et al., "Improved FBG-Based Shape Sensing Methods for Vascular Catheterization Treatment," in IEEE Robotics and Automation Letters, vol. 5, no. 3, pp. 4687-4694, July 2020, doi: 10.1109/LRA.2020.3003291.
- Accuracy of reconstructed 2D and 3D shapes based on 10 “ground truth” functions

TABLE III

EFFECTS OF DIFFERENT TECHNIQUES ON FINAL SHAPE ERROR

Technique	Max. error (%)
NTC + NO + RK + LIN	5.35
WTC + NO + RK + LIN	2.01
WTC + WO + RK + LIN	1.13
WTC + WO + HEM + LIN	1.11
WTC + WO + HEM + CUB	1.03

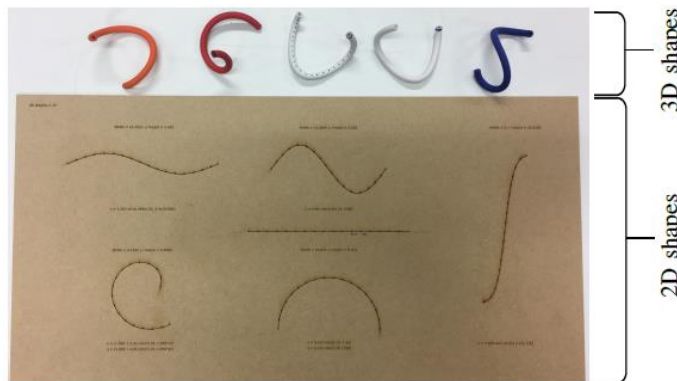


Fig. 4. 2D and 3D reference shapes that serve as ground truth for the experiments.

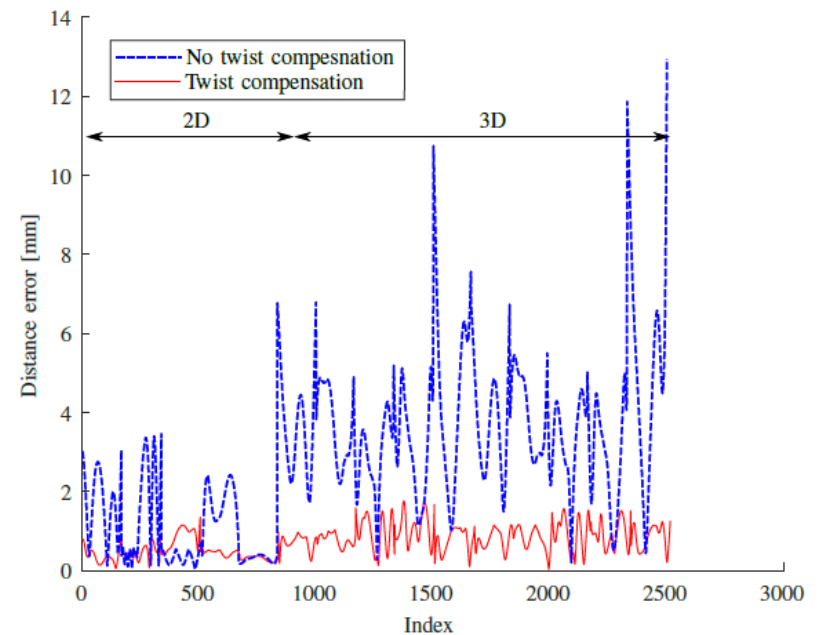


Fig. 6. Distance errors between ground truth and reconstructed curves with and without twist compensation.



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