Can Optical Techniques Replace X-ray for Interventional Guidance: Some Specifics

FRANS MOLL

Disclosure

- Consultant Medtronic
- Consultant Philips medical systems

Inventor of fiber Optics

How fiber optics work

“What fibre optics has done for communication, the wheel did for transport”

Advantages of Optical fibres

- Optical fibre reduces the high loss of information. Light could now travel huge distances without being lost – enormous masses of information could be put through the tiniest glass core
- Compared to many other forms of data transmission, fiber optics has exceptionally low data loss, a lack of power issues when traveling long distances and carries a much higher amount of data

Advantage of fiber optics integrated in medical devices

- MRI Compatible
- Safe for both patient and the surgeon
- Data can travel over a larger distance (non-sterile to sterile)
Fiber Optics in medical devices

- Illumination
- Imaging
- Measurements
- Endoscope
- OCT
- Biomedical sensors
- Benign/malign tissue differentiation
- 3D navigation

Complexity

Fiber Optics for illumination in medical devices

Complexity

First Presentation of 3-Dimensional Recontruction and Centefile-Guided Assessment of Coronary Afferent by Fusion of X-Ray Angiography and Optical Coherence Tomography

Complexity
Fiber-optic biomedical sensors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Fiso, LumitSense, Neoptix, OptSens, RJC</td>
</tr>
<tr>
<td>Pressure</td>
<td>Fiso, Megnet, OpSens, Samba Sensors, RJC</td>
</tr>
<tr>
<td>Coronary imaging</td>
<td>InfraRedx</td>
</tr>
<tr>
<td>Oxygenation</td>
<td>ISS</td>
</tr>
<tr>
<td>Pulse oximeter</td>
<td>Nonin</td>
</tr>
<tr>
<td>Blood flowmeter</td>
<td>ADInstruments</td>
</tr>
<tr>
<td>Shape/position</td>
<td>Hansen Medical, Intuitive Surgical, Luna, Measurement, Technolgi</td>
</tr>
<tr>
<td>Force</td>
<td>EndoSense</td>
</tr>
</tbody>
</table>

Fiber Optics with Force sensor

Fiber Optics for compression measurements

Fiber optics used to measure intervertebral disc bulging under compression

Fiber optics for urodynamic measurements

Real-time Tissue characterization
- Benigne vs maligne tissue
- Biopsy needle
- Surgical Knife with tissue feedback
Fiber Optics in medical devices

Illumination
Endoscope
Imaging
OCT
Biomedical sensors

Measurements
Benign/malign tissue differentiation

Guidance
3D (needle) navigation

Complexity

Fiber Optics for needle guidance

Needle length: 150 mm
Diameter of optical fiber: 0.25 mm
Diameter of inner stylet: 1 mm

Optical fiber

Tip
Sensing element

Optical fibers for guidance

Summary

X-ray vs. Optics

The room is ready for Optics