Paper Presentation

Robotically Assisted Cochlear Imaging

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Background
Our Approach

Imaging system: OCT → Micro-Borescope
Paper Selection


Material & Methods

- Optical Coherence Tomography

Figure 1. Schema of optical coherence tomography (OCT) (explanations are given in the text).

Pau et al. 2007
Different Applications of OCT

Pau et al. 2007
Material & Methods

- Preparation of temporal bones
  - Two temporal bone were grinded and cut for revealing the cochlear anatomy
  - Third temporal bone: preparations were performed as in real cochlear implant surgery

Figure 3. Temporal bone preparation (formalin-fixed temporal bone specimen, P1) with the cochlear endosteum exposed to the extent of approximately 1.5 x 1.5 mm (arrow). Slightly anterior to this ‘fenestration’ a cross-section through the temporal bone reveals the cochlear anatomy.

Pau et al. 2007
Results: OCT Scan

- SV: scala vestibuli
- ST: scala tympani
- BM: basilar membrane

Pau et al. 2007

Figure 4. OCT scan representing a vertical cross-section through the lateral part of the cochlea in the formalin-fixed temporal bone (P1). The membranous sheath of the cochlea can be seen between two portions of bone bordering the ‘fenestration’ (left and right). The lateral borders of the scalae (SV = scala vestibuli, ST = scala tympani) can be detected with the ‘ridge’ of the basilar membrane (BM) in between (arrow).
Results: OCT Scan

• Comparison of the OCT scan and the underlying anatomical structures

Pau et al. 2007
Results: OCT Scan

- The third fresh temporal bone

Pau et al. 2007
Discussion

• In the cochlear implant surgery …

Pau et al. 2007
Material & Methods I
Material & Methods II
Results I

- Fiducial registration error: 0.3 mm
- Target registration error: 0.25 mm
- Desired target registration error <0.5 mm

<table>
<thead>
<tr>
<th></th>
<th>Fiducial registration error (FRE, in mm)</th>
<th>Target registration error (TRE, in mm)</th>
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<tr>
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<td>4</td>
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<tr>
<td>Mean</td>
<td>0.3</td>
<td>0.25</td>
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Klenzner et al. 2009
Results II

- Endoscope advanced continuously
- No collision or interference
- No major aberration detected between the endoscopic view and the model of virtual endoscopy of the 3D dataset

Klenzner et al. 2009
Future Work

- better CT imaging to reduce the registration error
- CO2-laser to replace the drill to avoid occurring forces
- better robot mechanism
- noninvasive registration method

Klenzner et al. 2009
Questions?