Robotically Assisted Cochlear Imaging

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Clinical Advisor: Dr. Chien
Outline

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Background & Motivation
Project Goal

• The goal of this project is to develop a safe procedure to guide the electrode insertion in cochlear implantation by integrating the OCT imaging with the steady-hand robot.

• Components of this project:
  – A hardware adapter which allows an OCT probe (or multiple probes) to attach to the steady-hand robot
  – (A hardware adapter which holds the electrode of the implant for insertion)
  – A software component which will allow the probe to interface with current software.
Technical Approach

Microscope

Steady-Hand Robot

Temporal Bone

Microscope

Steady Hand

Cochlear

Side-View OCT
Side-view OCT

- Side-view OCT probe

Fig. 5. Photograph of a side viewing fiber probe with integrated lens.

J. Kang
Front View OCT

• One of our goals is to create a front-view OCT probe

• Combined with the side view, this can allow for a complete 3D picture of the cochlea
Deliverables 1

• Minimal
  – Develop a (rotationally-free) adaptor for OCT probe to be attached to the steady-hand robot
  – Develop a mechanism for the rotation ( +/- 180° ) of the OCT probe inside the cochlear canal (if needed)
  – Develop software to control the rotation of OCT probe inside the cochlear canal

• Expected
  – Integrate a second imaging fiber into the OCT probe, directed forward, to increase maneuverability and the field-of-view
  – 3D reconstruction of the cochlear canal using the software available (if needed)
Deliverables 2

- Maximal
  - Develop a hardware adapter which holds the electrode of the implant for insertion
  - Design a bendable OCT probe
  - Generate virtual fixture from the 3D reconstruction of the cochlear canal
  - Suggest safe insertion paths to the surgeon
  - Provide proximity-scaled force-feedback to the surgeon
## Timeline

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February | March | April | May
Dependencies

1. OCT system and software (Dr. Kang)
2. Access to phantom bones and clinical advice (Dr. Chien, clinical advisor)
3. Access to steady-hand robot and the software engineers
4. $2000 budget for manufacturing OCT adapters
6. Access to a motor (Dr. Kang) for testing
Responsibilities

• Xingchi:
  – Design the fixture and rotation mechanism in CAD
  – Generate virtual fixture, safe insertion path planning
  – Integrate front-facing OCT probe with side-view probe

• Saumya:
  – Software to control the OCT probe; interface with steady-hand robot
  – 3D reconstruction of the cochlear canal
  – Generate virtual fixture, safe insertion path planning

• Alperen:
  – Design the fixture and rotation mechanism in CAD
  – Generate virtual fixture, safe insertion path planning
  – Integrate front-facing OCT probe with side-view probe
Management Plan

1. Weekly meeting with Dr. Chien (if he is available)
2. Weekly meetings with each other on Tuesday and Thursday
3. 50 man hrs total per week


Temporal Bone

- Temporal Bone