Constructing a Model of the Cochlea From OCT Images

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Presentation Outline

- Overview
- Project Goals
- Technical Summary
- Project Management
- Bibliography

Photo Credit: NIH

- External parts of system
  - Microphone
  - Speech Processor
  - Transmitter
- Internal System
  - Receiver/stimulator
  - Electrode array

- How does the cochlea work?
- Parts of a cochlear implant
- How do cochlear implants correct hearing loss?

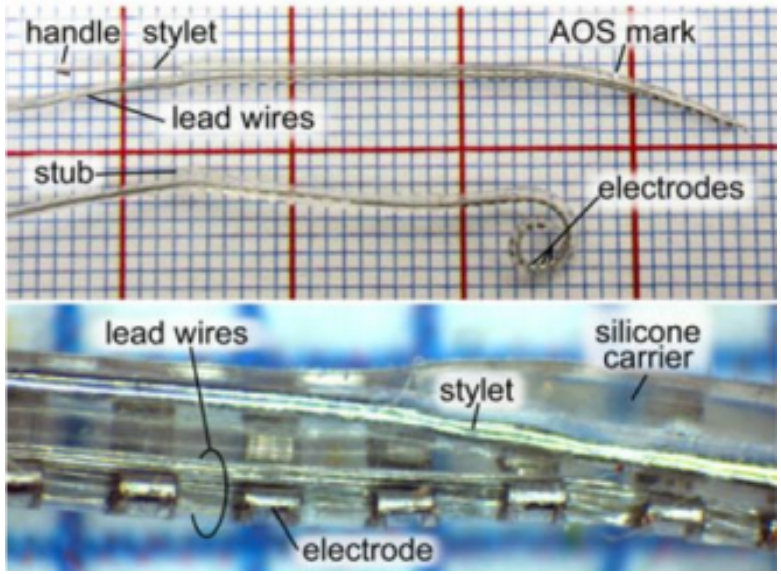

Photo Credit: Kratchman et al.

Photo Credit: Paul Wilkening

- Standard practice for cochlear implant electrode array insertion
- Problems with standard practice
  - Visibility
  - Required precision
  - Sensitivity of cochlea
  - Hand tremor
- Our Project Goal

- Overview of robot-assisted surgical system
  - EyeRobot2
  - Stereo Microscope
  - Monitor
  - Surgical Workstation Computer
    - CISST & eyeSAW Libraries
- Image cochlea in 2 ways (OCT)
  - What is OCT?
  - Side-viewing Probe
  - Bulk Scanner
- Create a Model
- Create Virtual Fixtures Based on Model

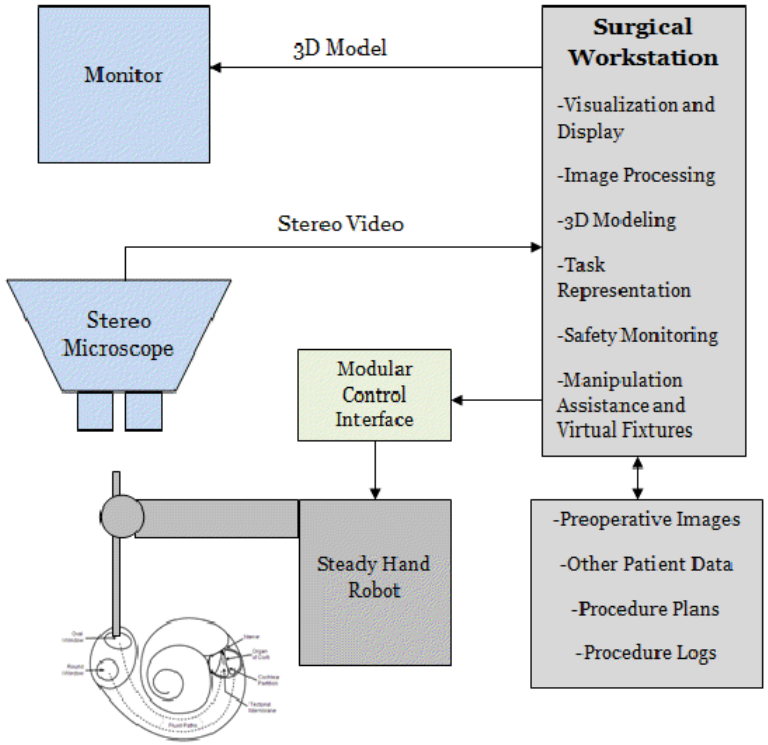

Photo Credit: Paul Wilkening

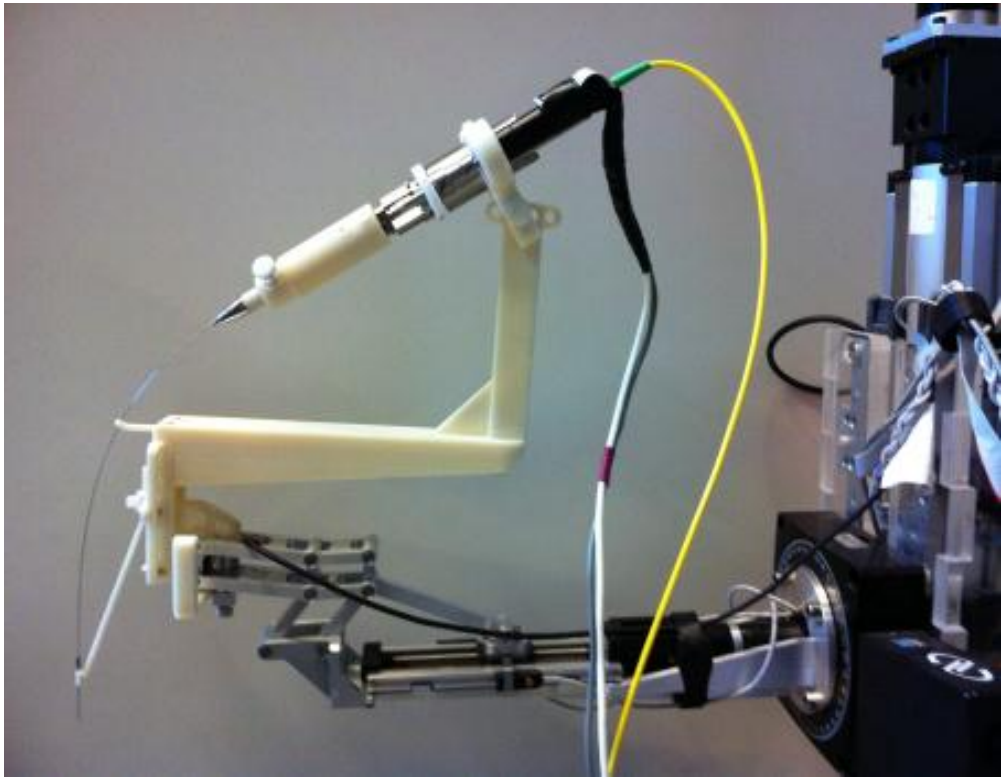

Photo Credit: Berk Gonenc

Side-viewing Probe

- Probe mounted to robot
- Parts
  - Motor
  - Trocars
  - Stainless Steel Tube
  - Glass Fiber
  - Sheath
  - Infrared laser
- How it works
  - A-Scans
  - B-Scans

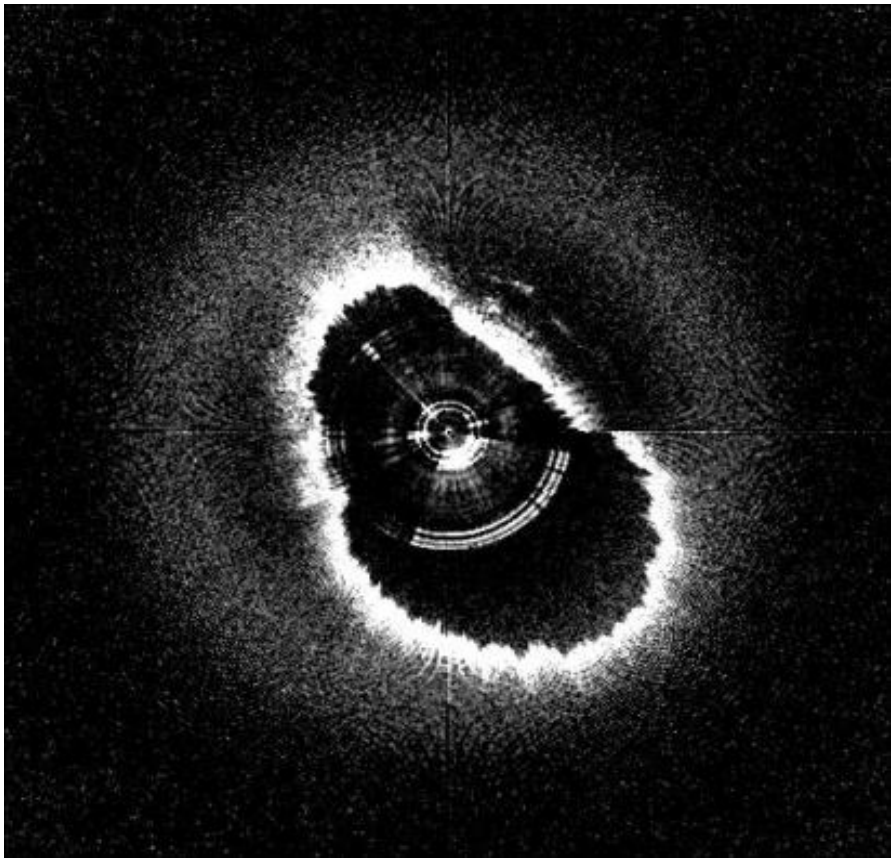

Photo Credit: Saumya Gurbani

Side-view Probe Data

- Pulse from robot
- Contour data from B-scans
- Multiple B-scans at different depths into the cochlea
  - Model
  - Virtual Fixture

Bulk Scanner

- Scanner mounted to robot
- How it works
  - A-Scans
  - B-Scans
  - Volumes

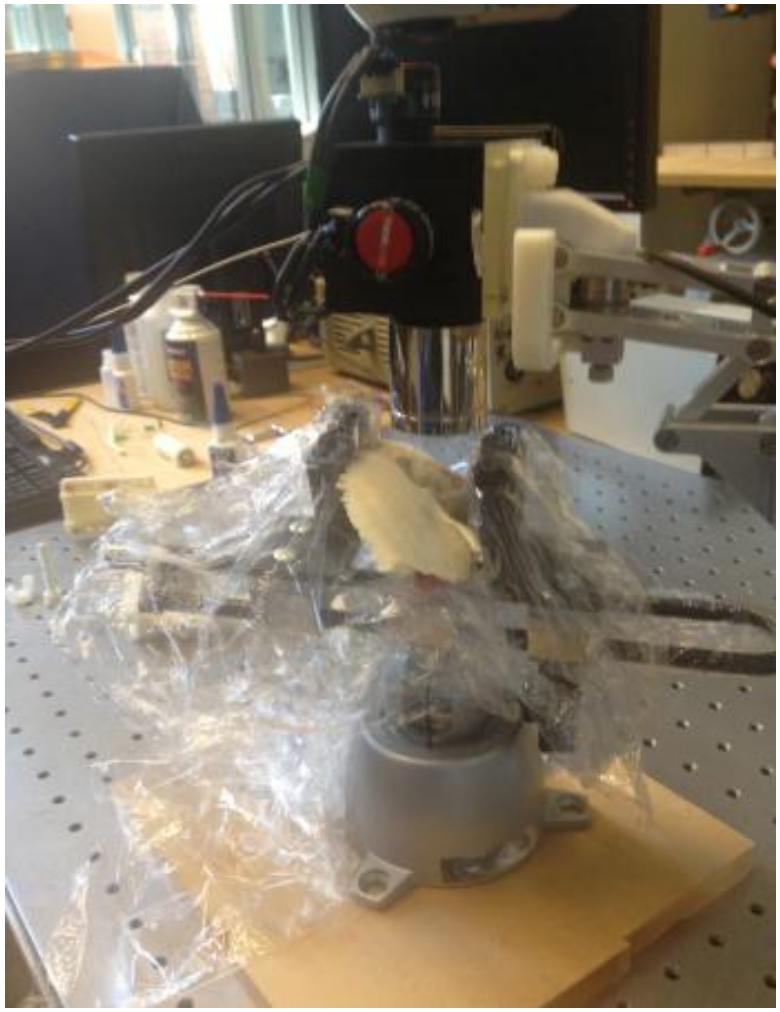

Photo Credit: Emily Daggett

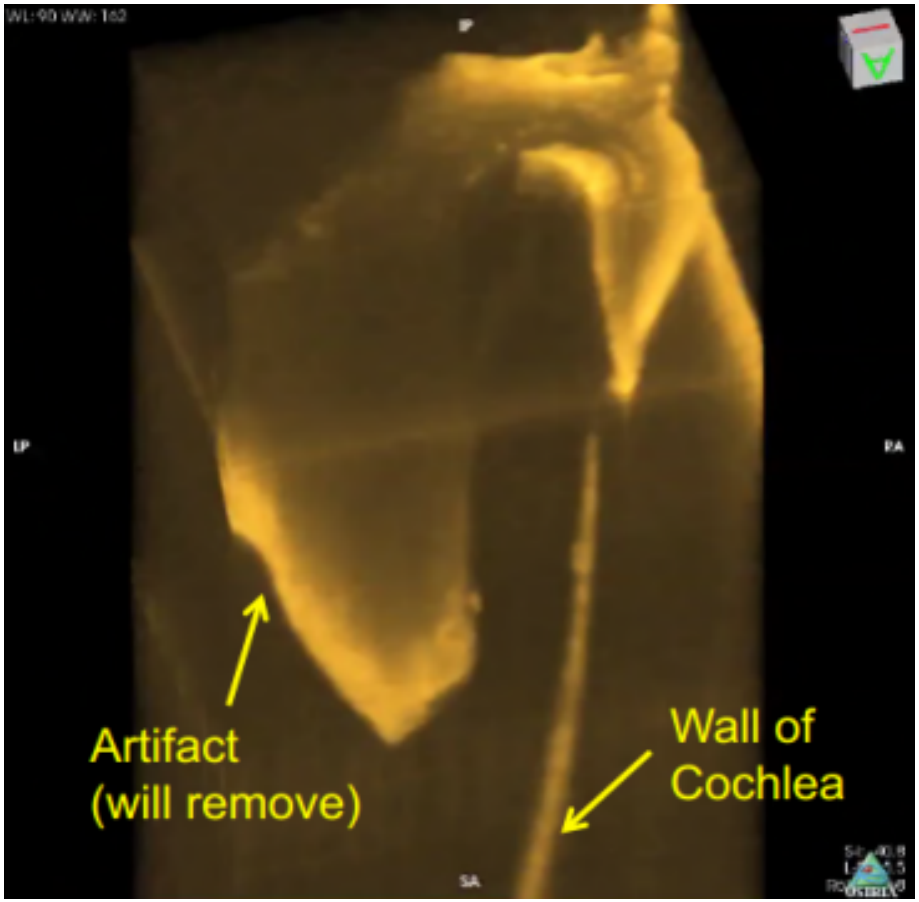

Photo Credit: Mingtao Zhao

Bulk Scanner Data

- Volumes stitched together
  - Model
  - Basal turn identified
  - Virtual Fixture

Project Management

Deliverables

Minimal	1. Separate OCT bulk scan and side-view probe models
	2. Working side-view virtual fixture
Expected	1. Registration overlay of OCT bulk scan and side-view probe models
	2. Working bulk scan and rotation virtual fixtures
Maximal	1. Fine-tuned combined model presentation for intraoperative use
	2. Complete, working, user-friendly system

Project Management

Dependencies

	Dependency	Plan/Source	Status/Comments
1	Bloodeborne Pathogen Training	Take online class	Done
2	Fire Safety and Hazard Communication Training	Take online class	Done
3	Engineering and Clinical Mentors	Schedule weekly team meeting	Scheduled
4	OCT Bulk Scan	Mingtao	Available
5	Side-View OCT Probe	Saumya	Available
6	EyeRobot2	LCSR	Available
7	CISST Libraries	Training	Available
8	Cochlear Phantom	LCSR	Available
9	Dry/Wet Temporal Bones	Iulian	Available
10	Detecting Contours in B-scans	Saumya	Pending refinement
11	Control Optimizer Library	Paul	Pending review
12	Bulk Scan Stitching	Mingtao	Available
13	Side-view Probe Calibration	Iulian	Pending fabrication of calibration object

Project Management

Stage	Task	2/4	2/11	2/18	2/25	3/4	3/11	3/18	3/25	4/1	4/8	4/15	4/22	4/29	5/10
Planning	Get acquainted with project code							SPRING BREAK							
	Demo for Cochlear			2/19											
	Project proposal			2/21											
	Documentation														
Bulk Scan	Get data														
	Calibrate														
	Get model data														
	Create a model														
Side-view Probe	Get data														
	Calibrate														
	Get model data														
	Create a model														
Combined	Find registration between models														
	Create comprehensive model (overlay one onto the other)														
Virtual Fixtures	Side-view-based virtual fixture														
	Rotation virtual fixture														
	Model-based virtual fixture														
Final Presentation															

Project Management

Management Plan
1. Weekly meeting with mentors to discuss progress and next steps
2. Weekly team meetings to review completed work, work on milestones, plan next steps, and complete documentation

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Questions?

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