Experimental Audiology Lab
Klinikum rechts der Isar
Technical University of Munich

Master's thesis: AI based Cochlear Implant Insertion Depth Estimation

Background

Cochlear implants (CIs) are effective neuroprostheses for patients with hearing loss. Knowing the position of CI electrodes can improve the hearing outcome for the patient. While postoperative radiographs like computed tomography (CT) accurately determine position, they are costly and expose patients to radiation. To address these concerns, an alternative technique without radiation exposure is required in clinical routine. CIs possess impedance telemetry capabilities, providing data on electrode contacts and allowing insights into intracochlear positions. However, existing methods fail to capture the complex relationships between impedance measurements and CT images. Deep neural networks offer a promising solution to overcome this limitation.

Aim

In this project, you will implement and test different deep learning techniques in an explorative dataset to estimate cochlear implant electrode insertion depth based on CT scans and impedance recordings from the cochlear implant.

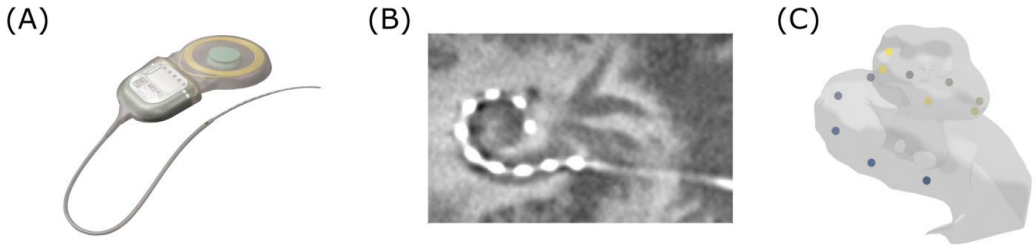

Abbildung 1: Figure: (A) Cochlear Implant (MED-EL, Austria) (B) Postoperative CT slice of the cochlear basal turn with CI electrodes (C) 3D visualization of the cochlea and electrode positions.

Your tasks

- Basic research (10%): Literature research is conducted on existing work for the application of deep learning in the field of cochlear implantation.
- Algorithm implementation and experiments (70%): Based on the literature research and your ideas, you will implement suitable neural networks to estimate electrode insertion depth (e.g., supervised autoencoders, CNN). Training data consists of about 100 pre- and postoperative CT scans of the temporal bone, with labels of the electrodes and cochlea, and impedance recordings from the implants.
- Results analysis (20%): Analysis of regression results and comparison with benchmark statistical machine learning methods (e.g., XGBoost, Support Vector Regression).

Your profile

- Master's student in the field of biomedical engineering, electrical engineering, computer science or a similar area
- Basic Python programming knowledge (PyTorch as a bonus)
- Strong motivation and scientific curiosity

We offer

- Opportunity to engage in innovative clinical research as part of an interdisciplinary team
- Collaboration with experts from the Bern University Hospital, Switzerland
- Participation in a young, welcoming and interdisciplinary research group
- Continuous supervision and mentorship on site for the whole duration of the project
- Workspace at the Klinikum rechts der Isar at Max-Weber-Platz with good accessibility by public transportation

Application

If you're interested in the topic, don't hesitate to send us an email with your application documents (e.g., CV and transcript of records).

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