ESR2. Data analysis, modeling, and prediction of underperforming cochlear implant patients based on individual anatomy (CT), brain signals (EEG), and audiological tests

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Understanding the causes for poor cochlear implantation outcomes is a difficult research challenge[1]. Therefore, we will investigate both technological factors (i.e. dimensions and placement of the cochlear implant, etc.) and biological factors (i.e. inter-individual variation of cochlear size and shape) and then analyse both regarding hearing outcomes in adults with cochlear implants. For cochlear implantation, it is critical for otologists to get insight into a patient's specific anatomy through CT imaging of the temporal bone[2], but it is complicated for both surgeons and radiologists to manually segment the relevant anatomical structures in temporal bone[2]. Hence, we plan to create a 3D automated classification and segmentation pipeline (on 3D temporal bone CT scan). The algorithms of histogram based intensity thresholding, or region based segmentation, different deep learning models (CNN, etc.), different machine learning models (random forest, etc.) and image registration are planned to be implemented and compared by different metrics. We currently use 3DSlicer to generate the minimum amount of manually segmented data required for each algorithm, as an input to the model or as a reference for evaluation (ground truth). Different qualitative/quantitive image assessments (DSC, etc.) will be integrated to compare the performance of different algorithms. We currently have a preliminary result (with low accuracy) on a 2d binary classification of single/multiple slice(s) of a 3D CT scan, to determine whether there is a cochlear presence on the selected slice(s). A heat map has been generated based on the probability of the presence of the cochlear in different regions given by the binary classifier. We are planning to implement different approaches to improve the performance of this algorithm. Results will be shown and discussed during the poster session of the Comm4CHILD workshop.

1. Pisoni D. B., Kronenberger W. G., Harris M. S., Moberly A. C. (2017). Three challenges for future research on cochlear implants. World Journal of Otorhinolaryngology-Head and Neck Surgery, 3(4), 240–254. https://doi.org/10.1016/j.wjorl.2017.12.010

2. Neves C. A., Tran E. D., Kessler I. M., Blevins N. H. (2021). Fully automated preoperative segmentation of temporal bone structures from clinical CT scans. Sci Rep,11(1):116. https://doi.org/10.1038/s41598-020-80619-0