Extension of Deep Learning-Based Automated Segmentation of Resection Cavities on Postsurgical Epilepsy MRI

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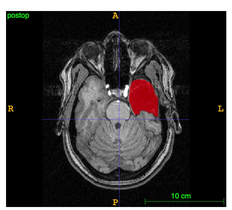
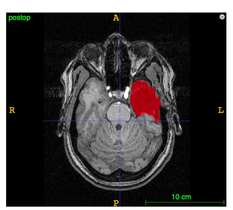
Introduction

- Epilepsy affects **sixty-five million** people worldwide.
- **Surgical removal** of the epileptic focus is the **recommended treatment** for drug-resistant TLE.
- Methods for automated Segmentation of Resection Cavities can be used to **quantify the resection's extent**.
- Quantitative assessments of resection have been identified as **significant predictors of surgical outcome**.

Figure 1: Manual Segmentation vs U-Net CNN Segmentation



Manual Segmentation



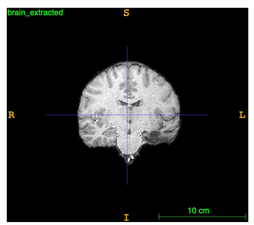
U-Net CNN Segmentation

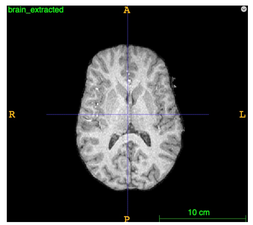
- Our lab previously developed a Deep learning-based algorithm for segmenting resection cavities on postsurgical epilepsy MRI.
- Here we implemented a majority vote algorithm to improve model performance and robustness.

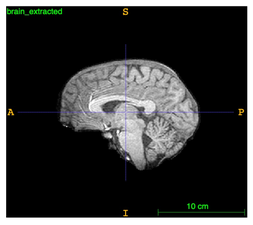
Methods

- Data: MRI scans from **44 temporal lobe epilepsy patients** who had surgery at the Hospital of University of Pennsylvania or Vanderbilt University Medical Center.
- All 3D volumetric **images were normalized** to a standard intensity range [0-1].
- Images were processed for **axial**, **coronal**, and **sagittal** views.
- Trained different models for each view, i.e., separate models for **sagittal**, **coronal**, and **axial**.
- The models use a **U-Net CNN architecture** and training was done using the **Keras API with TensorFlow backend**.

Figure 2: coronal, axial, and sagittal views of a patient's brain

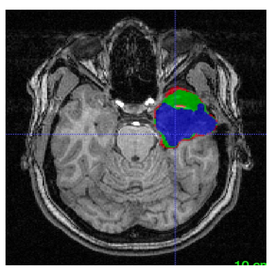




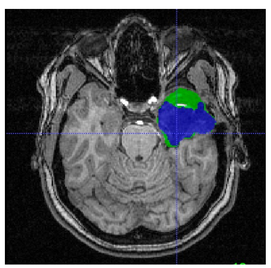


- Used a **majority vote algorithm** to run inference and determine if a voxel should be in the generated mask or not.

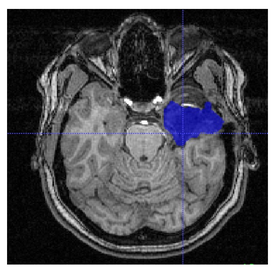
Figure 3: Output after running the majority vote algorithm



≥1 Vote



≥ 2 Votes

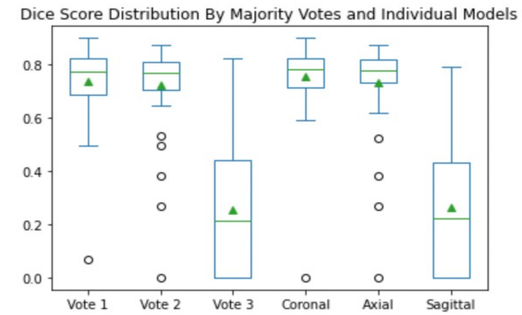


3 Votes

- Performance was measured using **Dice-Sørensen coefficient** (DSC), which identifies the overlap between the manual segmentation and the U-Net CNN Segmentation

Results

Figure 4: Dice Score Distribution by Majority Votes



- Axial/Coronal model is the highest performer.
- Sagittal model performed poorly and likely impacted majority vote models.

Future Work

Investigate the sagittal model and see how we can improve its performance.

Acknowledgments

I would like to thank my advisors Kathryn Adamiak Davis, M.D., M.S.T.R. and Thomas Campbell Arnold, Bioengineering PhD Student, University of Pennsylvania.