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Deep Residual Inception Encoder-Decoder Network for Amyloid PET Harmonization

It is estimated that more than 6 million Americans may have dementia caused by Alzheimer's disease (AD). Currently, AD is ranked as the seventh leading cause of death in the US. While several proteins have been implicated in AD, two, beta-amyloid and tau, are considered the defining pathologies of AD. Amyloid and tau imaging has subsequently become a crucial tool in defining AD in its preclinical stage as well as in clinical trials for treatment assessment and target engagement. Because of this, a number of radio-labelled tracers have been developed to enable in vivo detection and quantification of amyloid and tau burdens using positron emission tomography (PET). With multiple PET tracers for the same target pathology, acquired imaging data displays tracer-dependent characteristics, posing challenges to consensus interpretation and quantitative analysis.

Researchers at Arizona State University in collaboration with colleagues at Banner Alzheimer's Institute have developed a novel deep learning model to harmonize images between amyloid PET image pairs. This Residual Inception Encoder-Decoder Neural Network (RIED-Net) works on image pairs made with Pittsburgh Compound-B and florbetapir (FBP) tracers. It was trained using a dataset with 92 subjects with a 10-fold cross validation. RIED-Net was able to improve the agreement in amyloid measures from two different tracers and is generalizable to external imaging data without additional tuning of the model. This model is robust to variabilities in imaging acquisition protocols and scanner differences when standard scanner harmonization protocols are implemented.

This model successfully applies deep learning techniques to harmonize amyloid PET images acquired using different tracers and demonstrates that RIED-Net is able to improve the agreement in amyloid measures.

Potential Applications

- Harmonizing amyloid PET images
  - Allows interchangeable use of amyloid tracers in research and clinical applications

Benefits and Advantages

- Focuses on voxel mapping
- Computationally affordable – can perform PET harmonization in 3D
- Trained using a dataset with 92 subjects with 10-fold cross validation
  - Further examined using an independent external dataset of 46 subjects
- Significantly stronger between-tracer correlations (P<.001) were observed after harmonization for both amyloid burden indices and voxel-wise measurements
- Generalizable to external imaging data and achieves favorable performance without additional tuning of the model
- This model is robust to variabilities in imaging acquisition protocols and scanner differences when standard scanner harmonization protocols are implemented
- Readily applicable to new FBP scans
- Further work on the model is ongoing – particularly to apply it to additional tracers

For more information about this opportunity, please see

Shah et al - Alzheimers Dement. 2022

For more information about the inventor(s) and their research, please see

Dr. Wu's departmental webpage

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