Harmonizing Imaging Data in the Rotterdam Scan Study Before and After Scanner Update

Research Line: Neuroimage Analysis & Machine Learning
Project type: Master Project
Approx. duration: 6 to 9 months

Background. The Rotterdam Study, established in 1989, is a population-based cohort located in the neighborhood Ommoord in Rotterdam. This study is designed to investigate causes and consequences of age-related diseases. All residents aged over 45 years are invited for extensive examination. Since 2005, a 1.5 Tesla MRI scanner has been operational at the research center, resulting in brain scans (T1, FLAIR, PD, DWI) in over 6,000 participants with up to 4 scans per participant (over 18,000 scans in total). This has produced a rich dataset for studying neurodegenerative disorders.

Problem statement. In 2020, the MRI scanner underwent a hardware update, including a replacement of the receiver coil. This modification changed the scanner's signal reception across different brain regions. Comparisons of scans from the same individuals before and after the update show notable differences in brain measurements. To enable longitudinal analysis, it is essential to ensure that the derived imaging biomarkers are robust and not influenced by scanner-related changes.

Proposed solution. Several harmonization strategies exist to address scanner-related variability in imaging data. A common feature-based method is ComBat [1]. Harmonization based on the raw images can be achieved by (generative) deep learning approaches [2].

Objectives

- Implement a feature-based harmonization technique
- Optional: Explore an image-based approach and compare with feature-based technique
- Evaluate harmonization using matched data acquired before and after the scanner update and using small replication samples (individuals scanned in close succession)
- Apply the harmonized data to answer a clinically relevant research question focused on longitudinal evaluation in 6,000 participants from the Rotterdam Study

Who are we looking for? A student with an interest in neuroimage analysis and epidemiology. Preferably with course in imaging processing, e.g., Biomedical Engineering track Medical Physics or Technical Medicine track Imaging & Intervention. A clinical program can be set up.

References

[1] Beer, Joanne C., et al. "Longitudinal ComBat: A method for harmonizing longitudinal multi-scanner imaging data." *Neuroimage* 220 (2020): 117129.
[2] Hu, Fengling, et al. "Image harmonization: A review of statistical and deep learning methods for removing batch effects and evaluation metrics for effective harmonization." *NeuroImage* 274 (2023): 120125.

Interested in this project?

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