Image Harmonization

Overall Pipeline

- Hello

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Motivation

- Multi-site imaging studies are becoming increasingly common.
- Combining imaging data across sites introduces non-biological sources of variation that arise from the use of different scanner hardware and acquisition protocols.
- Field strength, manufacturer, gradient nonlinearity, subject positioning, etc.
- "Scanner effects" or "site effects" are similar to "batch effects" in the genomics literature
- Known to affect measurement of regional volumes, cortical thickness, voxel-based morphometry, and more generally, structural, functional, and diffusion images.

Motivation

- Including scanner as a confounding variable does not work well (Rao et al. 2017)
- Several methods for estimating and removing unwanted sources of variation due to site/scanner have been adapted to neuroimaging data.
- In this tutorial we will use ComBat (Shinohara et al. 2014) (CITE) to harmonize cortical thicknesses from the ADNI data.

Cortical Thickness

- Several ways to measure cortical thickness
- General idea is to measure perpendicular from the white/gray matter boundary to the pial surface

ComBat

- ComBat has been shown to remove unwanted variation associated with scanners while preserving biological associations in the data.

Conclusions

- Data harmonization is an important step in any image analysis that combines data from different sites and/or scanners.
- ComBat has been successfully applied to DTI and cortical thickness data to remove scanner effects while preserving biological associations of interest (Fortin et al. 2016).
  - ComBat code is located at `https://github.com/Jfortin1/ComBat`

Website

http://johnmuschelli.com/imaging_in_r

References

Fortin, Jean-Philippe, Elizabeth M Sweeney, John Muschelli, Ciprian M Crainiceanu, Russell T Shinohara, Alzheimer's Disease Neuroimaging Initiative, and others. 2016. "Removing Inter-Subject Technical Variability in Magnetic Resonance Imaging Studies." *NeuroImage* 132. Elsevier: 198–212.

Shinohara, Russell T, Elizabeth M Sweeney, Jeff Goldsmith, Navid Shiee, Farrah J Mateen, Peter A Calabresi, Samson Jarso, et al. 2014. "Statistical Normalization Techniques for Magnetic Resonance Imaging." *NeuroImage: Clinical* 6. Elsevier: 9–19.