Predictive regression modeling with MEG/EEG: From source power to signals and cognitive states

P1609

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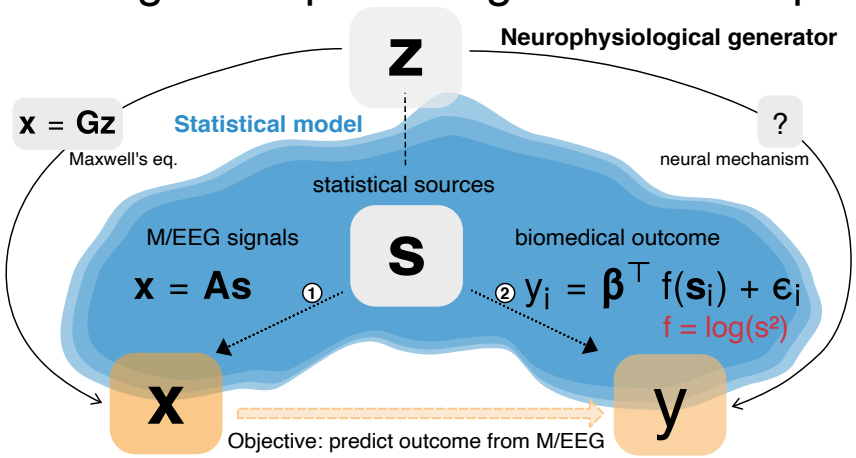
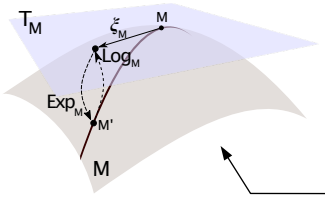
Volume conduction prevents classical linear modeling when predicting from source power.

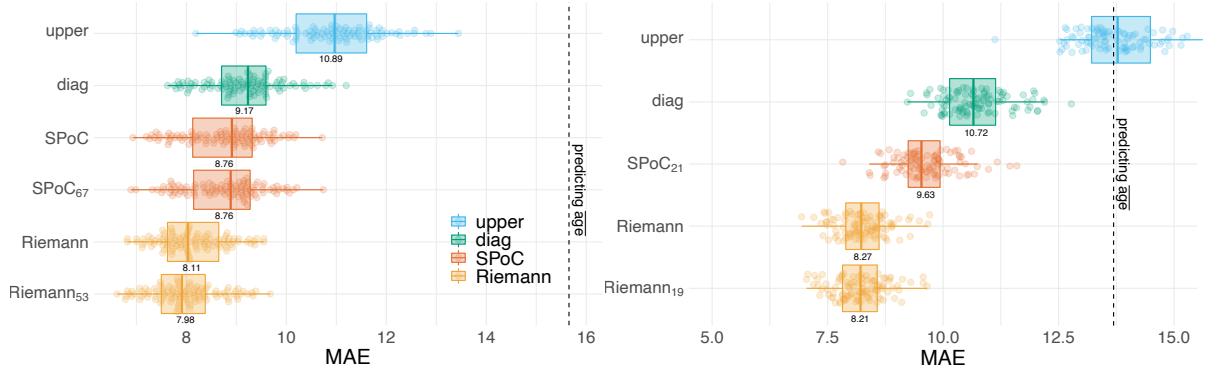




Idea: When using a linear model like Ridge regression to predict outcomes (y) from M/EEG (**X**), replace biophysical source model with mathematical-statistical transformation to regress out volume conduction. We considered spatial filters (SF) and Riemannian embeddings (RE). Baseline: sensor space power (*upper*) and log-power (*diag*).

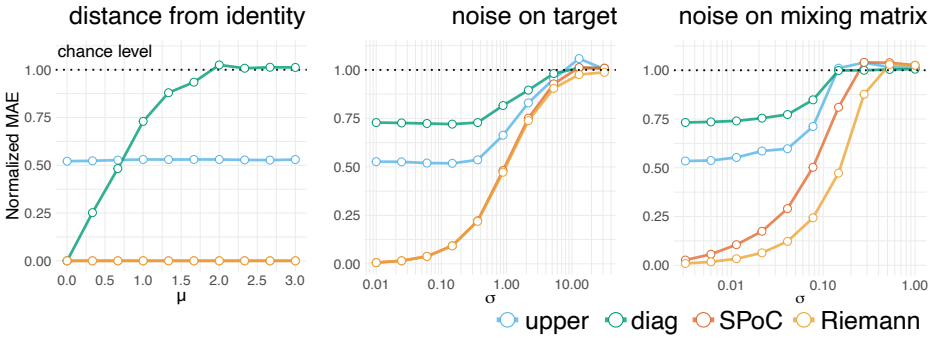
Riemannian embeddings perform best on real data.

MEG - Cam-CAN (n = 600) **EEG** - Temple Univ. Hospital (n = 1385)



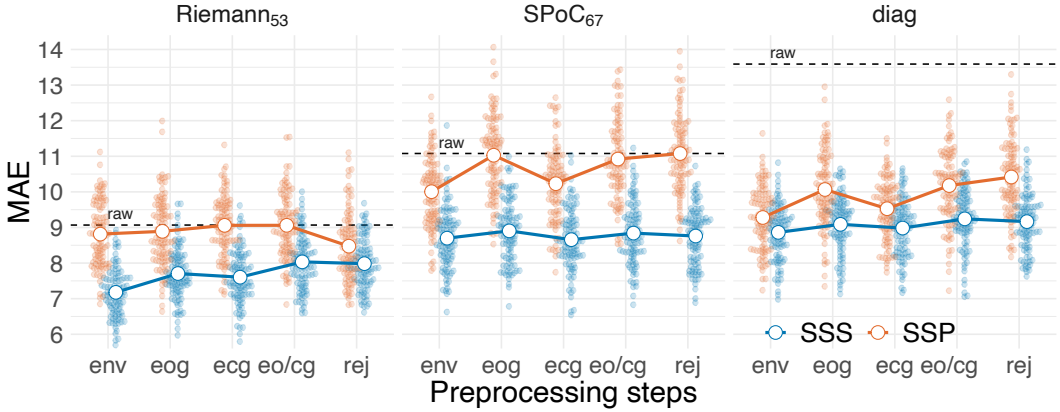
Note: We benchmarked methods against age-prediction with ridge regression. With source localization (MNE) as transformation, *diag* performed best ~ 7.7 yrs mean absolute error (MAE)!

Simulations: SF & RE yield consistent regression. RE were more robust to model violations.



Note: For prediction at the subject-level we encounter severe model violations as each individual has her own head and brain. This breaks mathematical guarantees.(See QR code for NeurIPS paper)

RE yielded robust regression models.



Note: We compared regression models across different combinations of preprocessing steps: denoising (SSP/SSS), ECG/EOG artifacts, rejection of bad segments. We even ran models with no preprocessing at all. RE is a clear winner. Caveat: Additional analyses also suggest that RE is most influenced by anatomical factors.

When prediction performance is the priority, Riemannian embeddings may beat source localization.