# Alzheimer's disease status can be predicted using a novel fractal-based metric computed from resting-state EEG

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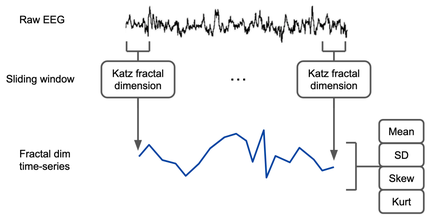
## Background

- Alzheimer's disease (AD) lacks a fast, easy, reliable, and inexpensive diagnosis.
- Several promising biomarkers (e.g. CSF[1], tau PET[2], MRI[3], blood[4,5]), but these are either expensive, invasive, or still in development.
- Here we develop a prototype diagnostic classifier based on novel metrics of brain activity in resting state EEG.

## Methods

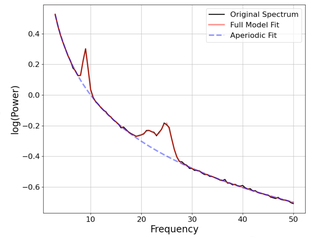
- Archival resting-state EEG
- Recruited from a memory clinic and university-based clinic
- A range of clinical diagnoses
  - SCI, MCI, and dementia
- A range of pathologies
  - AD, vascular dementia, and Lewy body dementia, TBI, and depression
- XGBoost classifiers to detect AD using EEG, age, and sex
  - Model performance evaluated using cross-validation

## Banded Fractal Variability

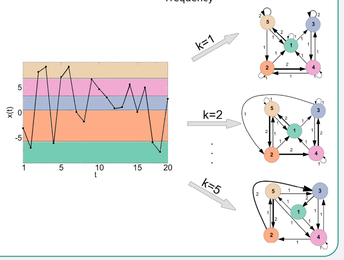



## Other features

FOOOF Spectral parameterization[6]



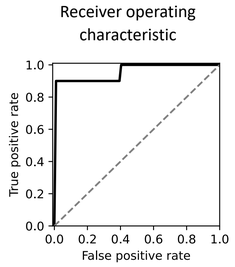

Quantile graph analysis[7]

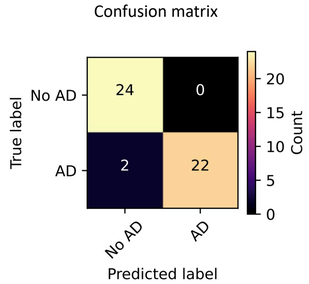



## Results

**Probable Alzheimer's disease vs. Healthy controls**
(N=48)

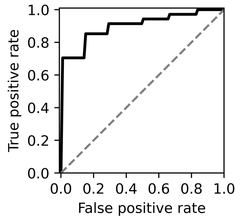
- AUC-ROC = 0.98
- Sensitivity = 0.92
- Specificity = 1.00
- Accuracy = 96%

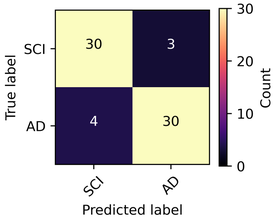



**Mild Alzheimer's disease vs. subjective cog. impairment**
(N=67)

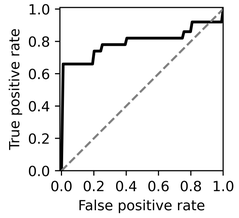
- AUC-ROC = 0.90
- Sensitivity = 0.88
- Specificity = 0.91
- Accuracy = 90%

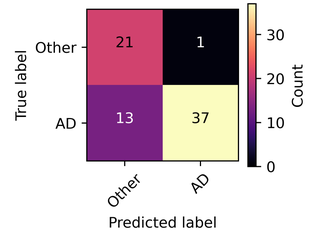



**Alzheimer's disease vs. other pathologies**
(N=72)

- AUC-ROC = 0.80
- Sensitivity = 0.74
- Specificity = 0.95
- Accuracy = 81%




## Conclusions

AD could be diagnosed in the clinic on the basis of machine-learning classifiers and resting-state EEG.

Banded Fractal Variability carries clinically-relevant information about AD.

## References

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[6] Donoghue et al. *Nature Neuroscience* 23.12 (2020).
[7] Pineda et al. *PLOS One* 156 (2020).