GRAPH CONVOLUTIONS ON SPECTRAL EMBEDDINGS: LEARNING OF CORTICAL SURFACE DATA

Gopinath K., Desrosiers C., and Lombaert H.
ETS Montreal, Canada.

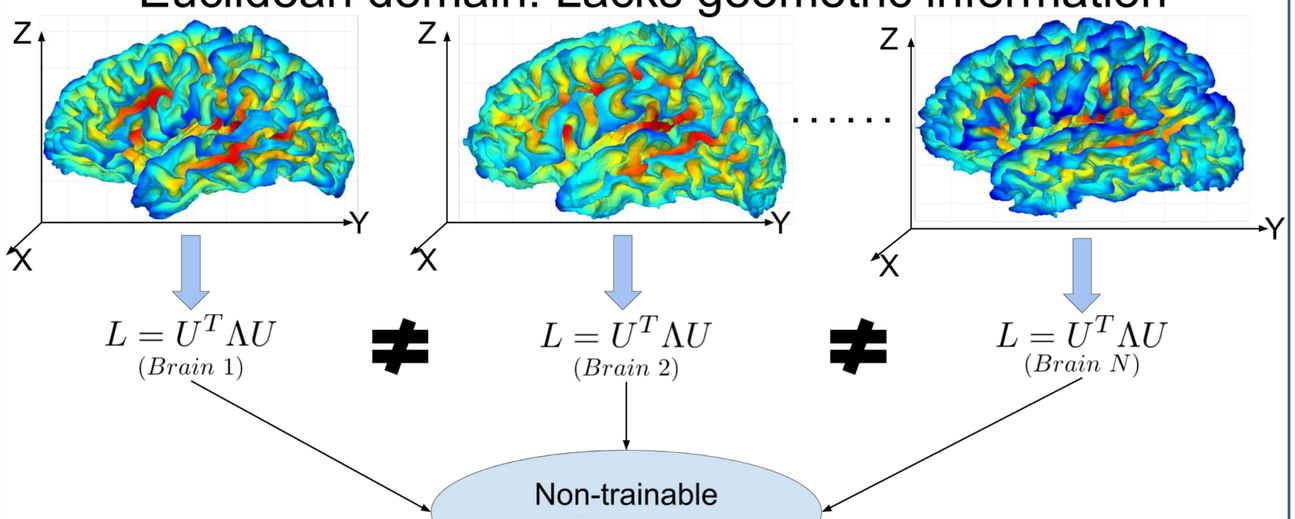
Le génie pour l'industrie

Abstract

We propose a novel method for **learning directly on multiple surfaces** via spectral graph convolutions. The Standard method relies on **spherical inflation** and **slow mesh deformations**[1]. Graph convolution networks are **fast** but, **restricted** to a **single fixed-graph structure**, relying **on Euclidean representations** (as in [2]). ***Our contributions are multifold***. Graph convolutions for **multiple graph structures**. Geometry aware **spectral filters**. A **fast** surface based **algorithm** for **cortical parcellation**.

Limitations

Euclidean domain: Lacks geometric information

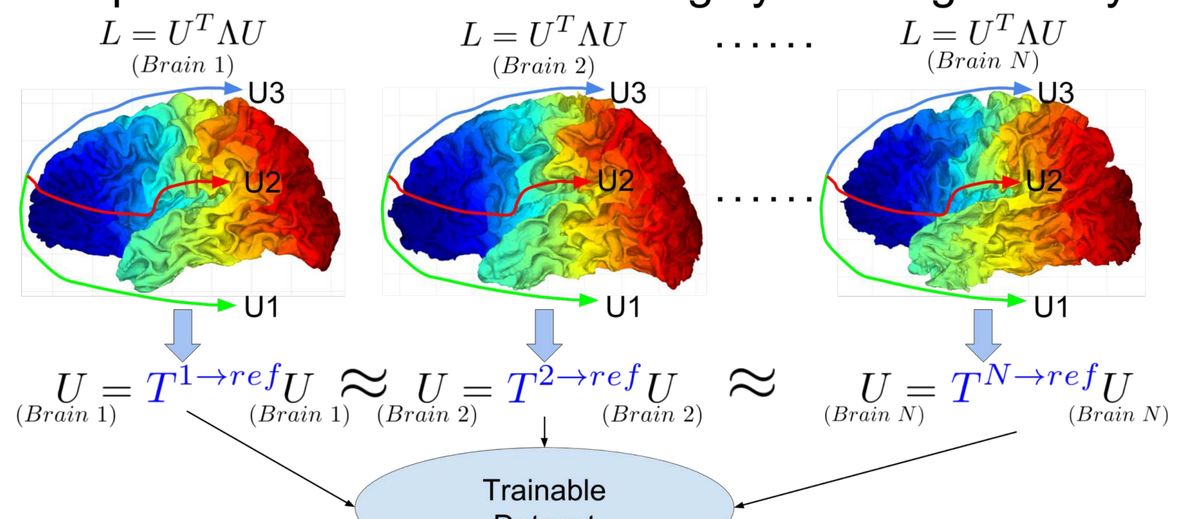


Laplacian **eigenbases incompatible** across **multiple geometries**

Incomparable spectral bases **to learn on surface data**.

Possible solution

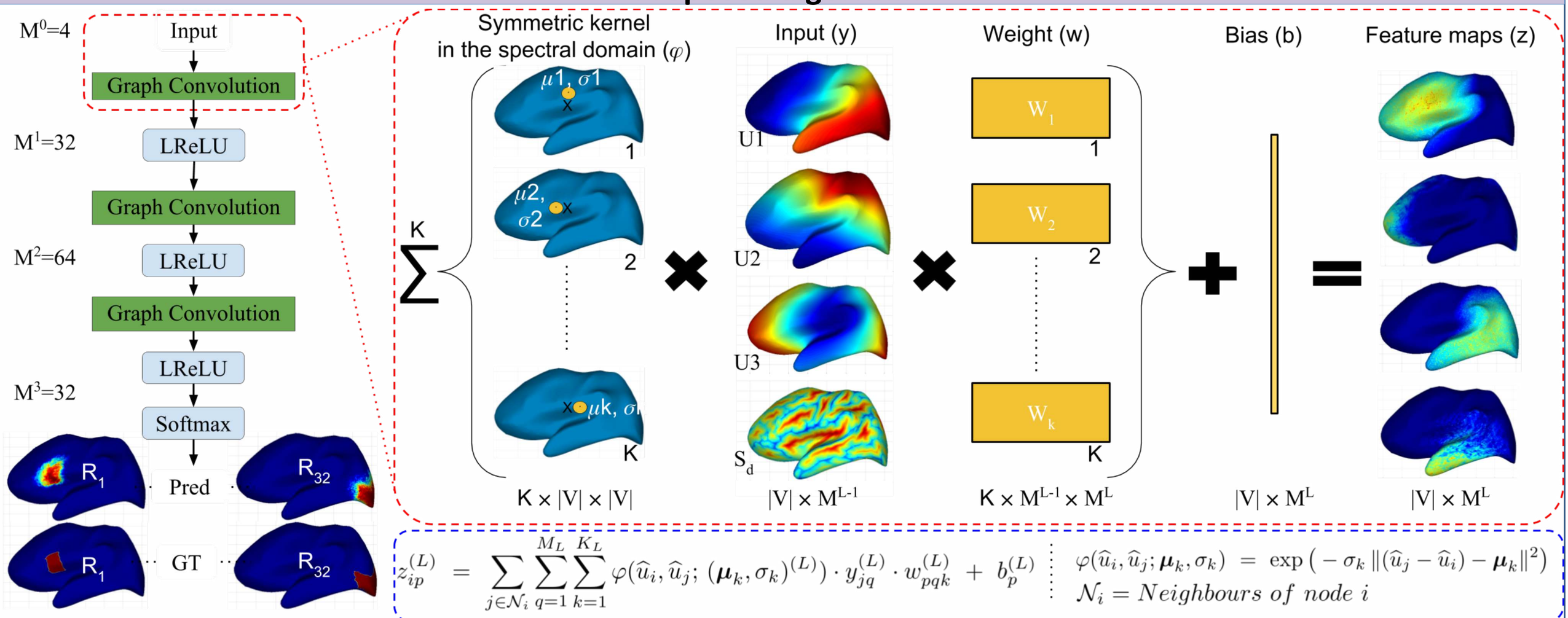
Spectral domain: Aware of highly folded geometry



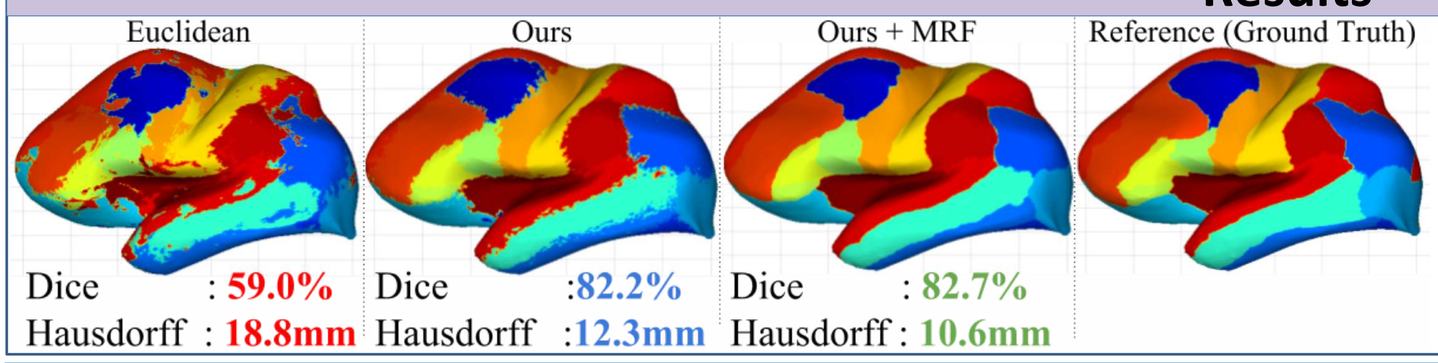
Comparable spectral bases **to learn across surfaces data**

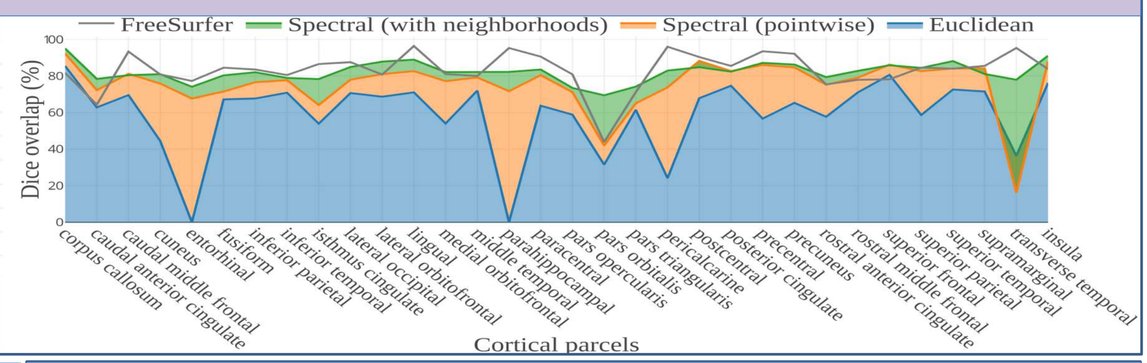
Spectral alignment with a reference to **compare different bases**.[3]

Proposed algorithm



Results





Conclusion

- **Proposal:** An algorithm for learning directly of the brain surface.
- **Time complexity:** 3 seconds vs. hours[1] for cortical parcellation.
- **Use:** Analyses of surface data, for finding new geometry-based biomarkers for neurological disorders.

References

[1] Fischl, B et al.: Automatically parcellating the human cortex. C.Cortex (2004)
[2] Monti, F et al.: Geometric deep learning on graphs using mixture model CNNs. CVPR. (2017)
[3]Lombaert, H et al.: Brain transfer: spectral analysis of cortical surfaces and functional maps. MICCAI. (2015)

NSERC CRSNG