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Multiscale Basis Dictionaries on Higher-Order Networks

Thursday 27 October 2022 10:10 (1 hour)

We have generalized the multiscale basis dictionaries (e.g., the Haar-Walsh wavelet packet dictionary and local cosine dictionary), which were developed for digital signals and images sampled on regular lattices and have a proven track record of success (e.g., audio/image compression, feature extraction, etc.), to for the graph setting. Our previous such basis dictionaries (e.g., Generalized Haar-Walsh Transform, Hierarchical Graph Laplacian Eigen Transform, Natural Graph Wavelet Packets, and their relatives) were developed for analyzing data recorded on nodes of a given graph. In this work, we propose their generalization for analyzing *data recorded on edges or on faces* (i.e., triangles) of higher-order networks, in particular, *simplicial complexes* (e.g., a triangular mesh of a manifold). The key idea is to use the *Hodge Laplacians* and their variants for hierarchical partitioning of edges or faces, and then build localized basis functions on those subsets. We demonstrate their usefulness for data approximation on simplicial complexes generated from a co-authorship/citation dataset and an ocean current/flow dataset. This is a vertically-integrated collaboration among a faculty member, a postdoc, and a graduate student.

Research

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Education and Outreach

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