Intertwinning wavelets or multiresolution analysis on graphs through random forests.

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Several methods are available to analyze signals on graphs, i.e functions defined on the vertices of a finite connected weighted graph. Fourier analysis requires the computation of the eigenvalues and eigenvectors of the graph Laplacian, it is also a non-local transformation. In this communication we propose a multiresolution scheme which provides well localized basis functions without requiring spectral computations. The approach relies on probabilistic tools: a random spanning forest to downsample the set of vertices, and approximate solutions of Markov intertwining relation to provide a subgraph structure and a filterbank which is a basis of the set of functions. As a by-product, the method provides a graph coarse- graining procedure. We illustrate the method by numerical experiments computed with the Python Package IntertwiningWavelet [4] developped by Dominique Benielli (Labex Archimède, Université Aix-Marseille) to process the method.

References

[1] Avena, Luca; Castell, Fabienne; Gaudillière, Alexandre; Mélot, Clothilde. *Approximate and exact solutions of intertwining equations through random forests.* arXiv:1702.05992v1 [math.PR].

[2] Avena Luca; Castell Fabienne; Gaudillière, Alexandre; Mélot Clothilde *Intertwinning wavelets or multiresolution analysis on graphs through random forests.* To appear in Applied Computational Harmonic Analysis.

[3] Avena, Luca; Gaudillière, Alexandre. *Two applications of random spanning forests.* Journal of Theoretical Probability, December 2018, Volume 31, Issue 4, pp 19752004. (see arXiv:1310.1723v4 [math.PR] for a preprint version with a different title).

[4] sources available on the git repository: `https://plmlab.math.cnrs.fr/archimede/intertwiningwavelet`, the Package is available on PyPi `https://pypi.org/project/IntertwiningWavelet/`.