Data-driven wavelet regression on graph

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Abstract:
Data acquired from large-scale interactive systems, such as computer, ecological, social, financial, or biological networks, are becoming increasingly widespread and accessible. Within modern statistical learning, efficient representation, processing, or analysis of such large-scale structured data, such as graphs or networks, are some of the key problems**.** Graph signal processing focuses on extending the theory and methodologies of standard signal processing to signals defined on the vertices of a graph. Increasingly popular due to the flexibility of the graph structure, this field of research, finds many areas of application. In this talk, we consider in particular the case of signal denoising (or regression) on graphs. The proposed methodology consists in applying a data-driven thresholding procedure in a well-chosen transformed domain, in which the signal is presumed sparsely represented. The threshold calibration is obtained by minimizing Stein's unbiased risk estimate (SURE), adapted to the chosen transformation. The overcomplete nature of the graph wavelet transform implies that a white noise is transformed into a correlated noise, thus, the divergence term in the SURE expression must be modified accordingly. To construct a fully data-driven procedure, we propose two new variance estimators of the noise. Furthermore, we provide an evaluation of the empirical performance of the method as well as a comparison with penalized estimators such as graph trend filtering (GTF). Numerically, this multi-scale approach shows better denoising performance compared to GTF (in term of mean square error), especially at high noise levels, while being computationally more efficient. Finally, we will discuss some perspectives and applications.

Keywords:
Stein Unbiased Risk Estimation, Graph Signal Processing, Regression, Tight Frame, Variance Estimation

References:
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