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Tree-Structured Wavelet Estimation of Spectra of Replicated Time Series in a Mixed Effects Model

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Abstract.
Wavelet thresholding provides a powerful tool for nonparametric estimation of spatially inhomogeneous curves. Plenty of thresholding techniques are available but linear ones show a lack of spatial adaptivity whereas nonlinear ones often suffer from unappealing visual aspects. Comparing different tree-structured wavelet approximations (see, e.g., Baraniuk, 1999) our investigations of the corresponding estimation schemes show that the construction of Engel (1999) allows to combine the simplicity of linear estimators with the adaptive denoising property of nonlinear schemes. On the theoretical side, it is known from approximation theory (Cohen et al., 2001) and from studying the mean-squared error for functions in certain smoothness classes (Autin, 2008) that tree-structured wavelet thresholding has some powerful near-optimality properties. As application we consider estimation of the population log-spectrum of several time series collected on human subjects within a mixed effects model framework. To face the problem of dimensionality we use the sparsity of tree-structured wavelet representations to construct an estimate based on pooled information carried over from all subjects. This allows for three objectives:

- improved denoising of the population spectrum,
- construction of a model-based estimator of the variability between subjects,
- prediction of the subject specific spectra.

Reference.

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