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# Stability of nonlinear multiresolution analysis


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Multiresolution plays a central role in image and geometry processing, data compression, noise removal, multilevel methods for operator equations, etc.

Multiresolution is characterized by a pyramid transform that consists of an analysis and synthesis step. The synthesis step is recursively defined by a two-scale operator $\tilde{v} = M(v, d)$, where $v$ and $\tilde{v}$ are coarse- resp. fine-scale data and $d$ is fine-scale detail. There is a complete theory for Lipschitz stability in the linear setting (i.e., when $M(v, d) = Sv + d$, where the subdivision operator $S$ is linear) but the theory is still in its infancy, when $M$ is nonlinear.

We have developed a general framework for proving Lipschitz stability in the univariate case that applies to $M(v, d) = Sv + d$, with $S$ nonlinear, includes stability of the corresponding subdivision scheme as a special case, and reaches further than previous theories (for example, covers the median-interpolating pyramid transform). For a large class of univariate schemes, our theorem is "close to optimal", i.e., its conditions for stability formulated in terms of joint spectral radius bounds for an associated family of nonlinear operators are not only sufficient, but also "almost necessary".

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