Detection of Edges in Spectral Data
and
Exponential Recovery Between Edges

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Abstract

We discuss the reconstruction of piecewise smooth data from (pseudo-) spectral information. Spectral projections enjoy superior resolution provided the data is globally smooth. The presence of jump discontinuities, however, is responsible for spurious O(1) Gibbs oscillations in the neighborhood of such jumps, and an overall deterioration to the unacceptable first-order convergence rate of spectral projections. The purpose is to regain the superior exponential accuracy in the piecewise smooth case, and this is achieved in two separate steps: (a) Localization. A detection procedure which based on appropriate choice of concentration factors which identify finitely many edges - both their location and their amplitudes. This is followed by (b) Mollification. We present a two-parameter family of spectral mollifiers which recover the data between the edges with exponential accuracy. We conclude with examples for applications in Computational Fluid Dynamics (– formation of shocks), image and geophysical data processing.