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Gibbs Phenomenon of Wavelets and Quasi-projection Approximation

Most data such as images are piecewise smooth functions. It is well known that the standard Fourier series approximation suffers the unpleasant ringing effect near discontinuity, which is termed as the Gibbs phenomenon such that the n th Fourier partial sums overshoot a function at jump discontinuities and the overshoot does not die out as n goes to infinity. Wavelets and framelets are known to be the mainstream multiscale sparse representation and approximation systems in data science. In this talk we study the Gibbs phenomenon of framelet/wavelet expansions and their associated quasi-projection approximation schemes at an arbitrary point. We show that the Gibbs phenomenon appears at all points for every tight or dual framelet having at least two vanishing moments and for quasi-projection approximation operators having at least three accuracy/approximation orders. This well explains the ringing effect of most wavelet approximation in applications. We shall also address how to avoid the Gibbs phenomenon for wavelets/framelets and quasi-projection approximation, as well as address the Gibbs phenomenon for approximation through sampling. This talk is based on [B. Han, Gibbs phenomenon of framelet expansions and quasi-projection approximation, *Journal of Fourier Analysis and Applications*, 25 (2019), 2923-2956].