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Fractional graph Laplacian for image reconstruction

Image reconstruction problems, like image deblurring and computer tomography, are usually ill-posed and require regularization.
A popular approach to regularization is to substitute the original problem with an optimization problem that minimizes the sum of two terms, an ℓ^2 term and an ℓ^q term with $0 < q \leq 1$. The first penalizes the distance between the measured data and the reconstructed one, the latter imposes sparsity on some features of the computed solution.

In this work, we propose to use the fractional Laplacian of a properly constructed graph in the ℓ^q term to compute extremely accurate reconstructions of the desired images.
A simple model with a fully plug-and-play method is used to construct the graph and enhanced diffusion on the graph is achieved with the use of a fractional exponent in the Laplacian operator. Since this is a global operator, we propose to replace it with an approximation in an appropriate Krylov subspace.

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