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Inversion and Super-resolution of Ultrafast Scattering

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We introduce a model-free method to directly resolve in real-space ultrafast diffuse scattering signals, below the diffraction limit and recover multiple atomic pair distance motions [1]. The method uses natural scattering kernels, a scattering basis representation that is composed of the measurement parameters and constraints, and the subsequent inversion analysis, and leverages signal priors, such as smoothness and sparsity to deconvolve the spatially transformed signals using convex optimization. We demonstrate super-resolution in real space on simulated and experimental scattering data and discuss the resolution limits vs signal fidelity.

[1] Natan, Adi. "Real-Space Inversion and Super-Resolution of Ultrafast X-ray Scattering using Natural Scattering Kernels." arXiv preprint arXiv:2107.05576 .(2021)

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