Incorporating bleaching into deconvolution

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Photophysics has been shown to be a powerful tool for microscopy. This suggests that a deconvolution approach that exploits photophysics where possible might demonstrate superb performance. As a first step toward broadly photophysics-aware deconvolution, we demonstrate a spatiotemporal deconvolution algorithm based on the same noise model as Richardson-Lucy deconvolution, but incorporating fluorophore bleaching. Compared to Richardson-Lucy, spatiotemporal deconvolution performs better near the band limit, displays reduced noise amplification, and in some instances can attain superresolution. While bleaching alone is a very limited subset of photophysical behaviors, we consider several setups where this technique is likely to be applicable.

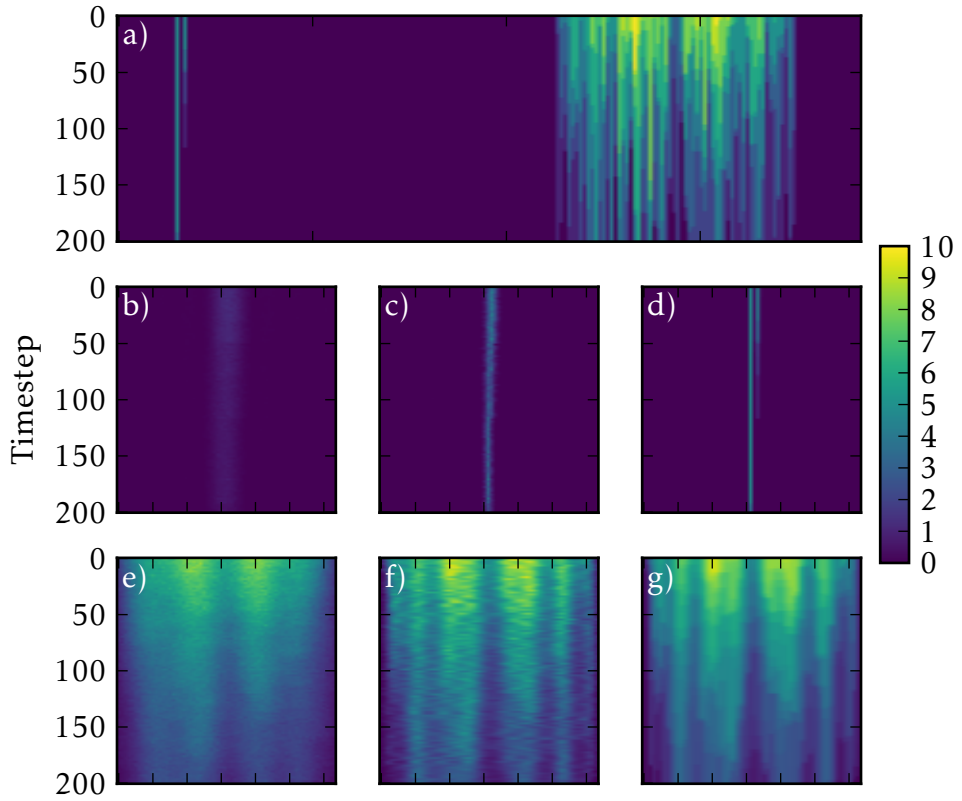

Figure 1: Spatiotemporal deconvolution on a 1D object with 200 timepoints, shown in (a). (b) and (e) show portions of the noisy blurred image; (c) and (f) Richardson-Lucy deconvolution of the image; (d) and (g) spatiotemporal deconvolution of the image.