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Enhancing Diffraction-Limited Images Using the Properties of the Point Spread Function ALEXANDER SMALL, Laboratory of Integrative and Medical Biophysics, National Institute of Child Health and Human Development, NIH, ILKO ILEV, Office of Science and Engineering Laboratories, FDA, AMIR GANDJBAKHCHE, Laboratory of Integrative and Medical Biophysics, National Institute of Child Health and Human Development, NIH — We propose a simple method for enhancing diffraction-limited microscope images, enhancing the resolution by at least a factor of two. In its simplest implementation, our algorithm is ideally suited for enhancing images obtained with near-field illumination, such as scanning probe microscopy of cells. We exploit the fact that the finite width of the point spread function introduces correlations between pixels in an image. Our method is much simpler than other methods for beating the diffraction limit, requiring no specialized equipment beyond the microscopes commonly found in biology laboratories, and only a single computational step to yield significant enhancements. We have theoretically analyzed the performance of our algorithm by generating images with point objects, and convolving those images with the point spread function (PSF) of a diffraction- limited lens. After enhancing the resulting images, we find that our method reduces the width of the PSF by a factor of two, and also yields a much steeper profile, enhancing contrast. Even when objects are too close to be resolved distinctly, our method enhances the aspect ratio of the resulting diffraction blur, clearly pointing to the existence of structure.

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