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IMAGE RESTORATION THROUGH SUBIMAGES AND CONFIDENCE IMAGES*

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Abstract. Some very effective but expensive image reconstruction algorithms cannot be applied to large images because of their cost. In this work, we first show how to apply such algorithms to subimages, giving improved reconstruction of regions of interest. Our second contribution is to construct confidence intervals for pixel values, by generalizing a theorem of O'Leary and Rust to allow both upper and lower bounds on variables. All current algorithms for image deblurring or deconvolution output an image. This provides an estimated value for each pixel in the image. What is lacking is an estimate of the statistical confidence that we can have in those pixel values or in the features they form in the image. There are two obstacles in determining confidence intervals for pixel values: first, the process is computationally quite intensive, and second, there has been no proposal for providing the results in a visually useful way. In this work we overcome the first of those limitations and develop an algorithm called Twinkle to overcome the second. We demonstrate the usefulness of these techniques on astronomical and motion-blurred images.

Key words. image restoration, regularization, confidence intervals, confidence images, motion blur, conjugate gradient method.

AMS subject classifications. 65F10, 65F20, 65F30.

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