

# Blind Image Deblurring Using Jump Regression Analysis

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Observed images are often blurred. Blind image deblurring is for estimating a true image from its observed but blurred version, when the blurring mechanism described by a point spread function is not completely specified beforehand. This is a challenging “ill-posed” problem, because (i) theoretically speaking, the true image can not be uniquely determined by the observed image when the point spread function is unknown, even in cases when the observed image contains no noise, and (ii) practically, besides blurring, observed images often contain noise, and the noise would bring numerical instability to the image deblurring problem. In the literature, early image deblurring procedures are developed under the assumption that the point spread function is known. More recent methodologies try to avoid this restrictive assumption, by either assuming that the point spread function follows a parametric form with one or more unknown parameters, or assuming that the true image has certain special structures. In this paper, we propose a blind image deblurring methodology, without restrictive assumptions on the point spread function or the true image. It even allows the point spread function varying over location. Our method makes use of the hierarchical structure of blurring that the image structure would be altered most significantly around step edges, less significantly around roof/valley edges, and least significantly at places where the true image intensity function is straight. So, it pays special attention to regions around step and roof/valley edges when deblurring. Theoretical justifications and numerical studies show that it works well in applications.