Revisiting Bayesian Blind Deconvolution

David Wipf, Haichao Zhang

(Submitted on 10 May 2013)

Blind deconvolution involves the estimation of a sharp signal or image given only a blurry observation. Because this problem is fundamentally ill-posed, strong priors on both the sharp image and blur kernel are required to regularize the solution space. While this naturally leads to a standard MAP estimation framework, performance is compromised by unknown trade-off parameter settings, optimization heuristics, and convergence issues stemming from non-convexity and/or poor prior selections. To mitigate some of these problems, a number of authors have recently proposed substituting a variational Bayesian (VB) strategy that marginalizes over the high-dimensional image space leading to better estimates of the blur kernel. However, the underlying cost function now involves both integrals with no closed-form solution and complex, function-valued arguments, thus losing the transparency of MAP. Beyond standard Bayesian-inspired intuitions, it thus remains unclear by exactly what mechanism these methods are able to operate, rendering understanding, improvements and extensions more difficult. To elucidate these issues, we demonstrate that the VB methodology can be recast as an unconventional MAP problem with a very particular penalty/prior that couples the image, blur kernel, and noise level in a principled way. This unique penalty has a number of useful characteristics pertaining to relative concavity, local minima avoidance, and scale-invariance that allow us to rigorously explain the success of VB including its existing implementational heuristics and approximations. It also provides strict criteria for choosing the optimal image prior that, perhaps counter-intuitively, need not reflect the statistics of natural scenes. In so doing we challenge the prevailing notion of why VB is successful for blind deconvolution while providing a transparent platform for introducing enhancements.

Comments:	This paper has been submitted to JMLR. A conference version will appear at EMMCVPR 2013
Subjects:	**Computer Vision and Pattern Recognition (cs.CV)**; Learning (cs.LG); Machine Learning (stat.ML)
Cite as:	**arXiv:1305.2362 [cs.CV]**
	(or **arXiv:1305.2362v1 [cs.CV]** for this version)

Submission history

From: David Wipf [view email]
[v1] Fri, 10 May 2013 15:09:11 GMT (1588kb)