

Comparative study of deblurring algorithms

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Introduction

Deblurring is the process of removing blurring from images. It is one application of signal deconvolution, which has been studied since the 70's. In this case, blurring is modelled as the convolution of a point spread function with a sharp input image. During four decades of studies, dozens of deconvolution algorithms have been developed. These include both blind deconvolution algorithms, in which point spread function is poorly defined or unknown, and algorithms which assume a model of point-spread function. Both approaches form an ill-posed inverse problem. In this case study, algorithms from both categories are included to a comparative study.

Methods and materials

In this study, a number of different algorithms are applied to same dataset: images of varying ISO values, blurred with various levels of focus aberration. Images are photographs taken in laboratory of industrial mathematics in Faculty of Mathematics and Statistics of Helsinki University. Subject matter of the photographs is still lifes or random office equipment.

Three algorithms with a model of the point-spread function are included in the study, these are truncated SVD algorithm, Tikhonov regularization and Total variation regularization. Form of the point-spread function is modelled with help of separate pictures, taken from a black hand-drawn dot, which is assumed to be a homogenous regular circle.

Beside these algorithms, a blind deconvolution algorithm using normalised sparsity measure by [Krishnan et al 2011] is included in the comparison.

Color images are used, which means that deblurring is applied separately to each color layer. Algorithms are compared according to sharpness and cleanness (that is, lack of noise) of the image reached with the deblurring. This is judged on qualitative basis by visual confirmation. A sample of resulting images is included in the poster for a reader to compare various algorithms on his own.

References

[Krishnan et al 2011] Krishnan D., Tay T., Fergus R. Blind Deconvolution Using a Normalized Sparsity Measure, IEEE CVPR 2011 Conference Colorado Springs.
http://cs.nyu.edu/~dilip/research/papers/priors_cvpr11.pdf