Recent advances in the reconstruction of astronomical images

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Abstract

The development of Adaptive Optics (AO) and the design and construction of new ground-based telescope utilizing this technique, has increased the relevance of image reconstruction/deconvolution methods in the processing of astronomical images. Indeed, in general, AO provides only a partial correction of the atmospheric blur and a further correction can be obtained by image deblurring. Moreover, interferometric instruments, as that under construction for the Large Binocular Telescope, will require routinely the use of image deconvolution for getting significant images.

An important point in Astronomy is that the reconstructed images must be sufficiently accurate for quantitative analysis (photometry, astronomy, dynamic range); in addition the images are very often characterized by a very high dynamic range (the same image can contain objects with very different magnitudes, a logarithmic scale used for characterizing the brightness of the objects). These features require a very accurate modeling of noise and the addition of suitable constraints on the solution.

In this talk, after an analysis of the constrained optimization methods that are relevant in Astronomy, we discuss an approach that has been recently proposed for the design of iterative methods based on a suitable scaling of the gradient. Convergence and implementation problems are briefly discussed.