Restoration of astrophysical images, statistical influence of the camera

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Abstract

Restoration of astrophysical images is a classical applied inverse problem. The astronomical object is first blurred by the Point Spread Function of the instrument-atmosphere set. The resulting convolved image is corrupted by a Poissonian noise due to low light intensity, then, a Gaussian white noise is added during the electronic read-out operation by the Charge Coupled Device (CCD) camera. For such data, the so-called Richardson Lucy algorithm or, more recently, a regularised version of it is used to restore the object from the data, both neglect the read-out noise. Very recent technology proposes to acquire astrophysic data with Low Light Level CCD (L3CCD) cameras in order to avoid the read-out noise due to the classical CCD acquisition. The physical process leading to the data has been previously described by a "Poisson Gamma" density. We propose to discuss the model and to derive an iterative algorithm for the deconvolution of such data. Some simulation results are given on synthetic astrophysic data pointing out the interest of using L3CCD cameras for acquisition of very low intensity images.