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Séminaire du LVA

In the land of the blind, the one-eyed man is king: non-blind, myopic, blind or shift varying deconvolution in biological imaging.

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From the telescope of Galileo to the recent Nobel prize about nanoscopy, many breakthroughs in instrumentation have lead to major scientific discoveries. However, some recent instrumental achievements have almost reached theoretical bounds in terms of performance (high throughput optics, very high quantum efficiency detectors, single molecule localization,...) and in some cases (e.g. in the visible domain) future improvements will be harder and harder to obtain. In biological imaging, beside fluorophore engineering and optics, signal processing may be one major source of future breakthroughs. Indeed, with the huge (and cheap) computing power now available, it is possible to numerically invert the image formation process and gather most of the information diluted in the data.

In this context, I will present my work in deconvolution - the archetype of these "inverses problems" - for 3D fluorescence micro-graphs with results on both simulated and real data. However, two main problems still prevent the dissemination of such a method in the bio-imaging community: (i) the lack of knowledge of the microscope response (the PSF) and (ii) the fact that this PSF may vary in depth and along the field of view. I will discuss two different approaches to estimate the PSF directly from the data: the blind deconvolution and the myopic deconvolution when the PSF is known up to few parameters. Finally, I will present some ways to model fast and accurate "shift variant" operators that will be used for deconvolution.