Approximation and Optimization in Image Restoration and Reconstruction
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ALGORITHMS FOR IMAGE RESTORATION AND RECONSTRUCTION MAKING USE OF THE MM PRINCIPLE

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In the years 1990, Half-Quadratic (HQ) algorithms have been proposed to minimize penalized least square criteria for edge-preserving image restoration purposes. They have been extensively used and studied since then. More recently, it has become clear that HQ algorithms are particular instances of a larger family of minimization algorithms that proceed along the Maximize-Minimize (MM) principle, also known as *iterative majorization*. More precisely, HQ algorithms rely on *quadratic* tangent majorant functions. However, the cost per iteration of HQ algorithms is often prohibitive for large scale problems, since each iteration involves the solving of a linear system of the same size as the image. Consequently, *truncated versions* are usually preferred in practice, at the price of leaving the MM framework.
In this talk, recent results will be presented, showing that truncated HQ algorithms possess the same convergence properties as the true HQ versions, even in the case of an arbitrarily strong truncation. Another family of algorithms will be introduced, where the MM principle is only used as a unidimensional minimization tool to choose the stepsize in given directions. In particular, convergence results will be given for non linear conjugate gradient methods using such an MM line search strategy.
The latter algorithms only apply to gradient-Lipschitz criteria. Therefore, they are not suited to minimize criteria containing a barrier function, such as those encountered in maximum entropy reconstruction or positron emission tomography. In particular, a barrier function admits no quadratic majorant function. Recent results rely on a scalar, nonquadratic majorant function to produce a new line search strategy for barrier function minimization. These results include the convergence of several descent methods suited to large scale problems, among which non linear conjugate gradient methods.