Regularized nonconvex minimization for image restoration

F. Di Benedetto, **C. Estatico**
Department of Mathematics, University of Genova
Via Dodecaneso 35, I-16146 Genova, Italy
estatico@dima.unige.it

Tikhonov regularization for the linear equation $Ax = y$ involves the minimization of a convex functional of type $\Phi(x) = Q(Ax - y) + \alpha G(x)$, where Q measures the residual term $Ax - y$, G is a penalty function incorporating the solution x or its derivatives, and α is the regularization parameter. In particular, both $Q(\cdot)$ and $G(\cdot)$ are the square of the L2-norm, $\|\cdot\|_2^2$, in the simplest case of classical Tikhonov regularization in Hilbert spaces.

In this talk, we discuss, in Banach spaces setting, a regularization functional Φ whose penalty term G depends on the model operator A, as introduced in [2] for Hilbert spaces. Furthermore, we solve the associated minimization problem by an iterative approach based on a variant of the Landweber method [1]. To speed up the iterations, otherwise too slow, a modification of the penalty term is used, leading to a nonconvex functional.

The obtained nonlinear algorithm has been applied to the linear problem of image deblurring, the removal of blur and noise from a digital image.

References

[1] T. Hein, K. S. Kazimierski, *Modified landweber iteration in banach spaces – convergence and convergence rates*, Numer. func. anal. opt., 10 (2010), pp. 1158–1184.

[2] T. Huckle, M. Sedlacek *Tikhonov-Phillips regularization with operator dependent seminorms*, Numerical Algorithms, 60 (2012), pp. 339–353.