Regularization of Inverse Problems using sparsity constraints – Analysis and Applications

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Abstract:

In this talk we consider the regularization of nonlinear operator equations $F(x) = y$. Assuming that the solution of the equation has a sparse expansion with respect to a preassigned frame or basis, we want to develop methods that also enforce a sparse reconstruction. This is usually not the case if e.g. Tikhonov regularization with a quadratic Hilbert space penalty term is used. Instead, we propose the use of a weighted ℓ_p norm, which allows for $p < 2$ sparse reconstructions. For $1 \leq p < 2$ we will propose iterative minimization strategies for the minimization of the Tikhonov functional by so called *Surrogate functionals*. We will also provide regularization parameter rules and give convergence and convergence rate results. Finally, some numerical results from medical imaging and for the inpainting problem will be presented.