Inverse Problems Network Meeting 2

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Isaac Newton Institute, Cambridge

Abstract of Talk

EXACT DISCRETIZATION AND SOLUTION OF CONTINUOUS-WORLD INVERSE PROBLEMS

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Regularization is a classical technique for solving ill-posed inverse problems, but it is usually imposed in the discrete domain. In this talk, we consider a continuous-world scenario where an unknown function f is probed with a finite number of linear functionals (forward imaging model) corrupted by measurement noise. The non-conventional aspect is our use of a continuous-domain regularization involving the L_p norm of Lf where L is a suitable differential operator. We present two representer theorems that provide the parametric form of the solution(s) of the reconstruction problem with Tikhonov ($p = 2$) vs. total-variation ($p = 1$) regularization. Remarkably, the solutions of both problems are (generalized) splines with the knots being fixed for $p = 2$ and adaptive (and fewer) in the total variation scenario. These findings suggest an exact discretization of the problem that can then be solved using finite-dimensional minimization techniques. We illustrate the theory with examples of signal reconstruction that confirm the sparsifying (resp., smoothing) effect of total variation vs. Tikhonov regularization.

Joint work with Harshit Gupta and Dr. Julien Fageot