Inverse Problems Network Meeting 3

Thursday, 26th April 2018 - Friday, 27th April 2018

Centre for Inverse Problems, UCL

Abstract of Talk

FINITE ELEMENT METHODS WITH WEAKLY CONSISTENT REGULARISATION FOR INVERSE PROBLEMS

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The classical way of approximating inverse problems is to first regularise the continuous problem, ensuring well-posedness and then approximate the resulting well-posed problem using standard techniques. Although conceptually straightforward and relatively easy to implement, this approach leads to a nontrivial matching problem for the discretisation and regularisation parameters. Typically the regularisation parameter is chosen matching perturbations in data. The mesh size is then chosen small enough so that all scales of the regularised problem is resolved. In this talk we will discuss an alternative approach where the ill-posed problem (i.e. without regularisation) is discretised using finite elements in an optimisation framework. To counter the severe ill-posedness of the resulting finite dimensional system we add weakly consistent regularisation terms drawing on known results from computational methods for fluids. We show how the resulting methods can be analysed, yielding optimal error estimates, using the numerical stability of the regularised finite element methods in combination with sharp conditional stability estimates derived from Carleman estimates. Both the effect of discretisation and perturbations in data are included in the estimates. Poisson's equation will be used as model problem in the stationary case and in the transient case we will consider the heat equation, some numerical examples will be given illustrating the theory.