

Hybrid Krylov Subspace Iterative Methods for Inverse Problems

Abstract:

Inverse problems arise in many imaging applications, such as image reconstruction (e.g., computed tomography), image deblurring, and digital super-resolution. These inverse problems are very difficult to solve; in addition to being large scale, the underlying mathematical model is often ill-posed, which means that noise and other errors in the measured data can be highly magnified in computed solutions. Regularization methods are often used to overcome this difficulty. In this talk we describe hybrid Krylov subspace based regularization approaches that combine matrix factorization methods with iterative solvers. The methods are very efficient for large scale imaging problems, and can also incorporate methods to automatically estimate regularization parameters. We also show how the approaches can be adapted to enforce sparsity and nonnegative constraints.

We will use many imaging examples that arise in medicine and astronomy to illustrate the performance of the methods, and at the same time demonstrate a new MATLAB software package that provides an easy to use interface to their implementations.

This is joint work with Silvia Gazzola (University of Bath) and Per Christian Hansen (Technical University of Denmark).