Micro Project 2: AIR Stopping Rules

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1 The Problem: Stopping Rules for Iterative Methods

Software packages with implementations of algebraic iterative reconstruction (AIR) methods provide a number of different methods, but surprisingly few of these package equip their methods with a stopping rule – except for the number of iterations. This is ok, as long as the user has a good intuition of how many iterations are needed. Nevertheless, it is interesting to study how well the standard stopping rules actually work, with an eye to their potential use in the ASTRA software package.

2 The Micro Project

This micro project is quite open-ended with the overall goal to investigate the implementation and use of the stopping rules presented in the lectures and exercises. In particular, it is interesting to study the reliability of these stopping rules when applied to larger problems solved by means of ASTRA. In the project it is up to you to choose which stopping rules, iterative methods, and test problems to use, as well as how to evaluate the performance, robustness and reliability of the stopping rules. A few ideas to get you started:

- In all your experiments, use artificial test problems where you know the ground truth such that you can determine the optimal number of iterations.
- Choose one or more of the three stopping rules fit-to-noise-level, UPRE and GCV, using one or both of the trace estimates $t^\text{est}_k$ and $t^\text{ref}_k$.
- You can also study the NCP stopping rule, but this one is more difficult to implement and therefore potentially more risky.
- Study the use of the stopping rules in conjunction with one or more of the methods ART, Cimmino, and the method called SART in AIR Tools and SIRT in ASTRA.
- You should probably start with experiments in MATLAB using small matrices, where you can initially compute the exact trace $t_k$.
- We hope you will also perform experiments with ASTRA on larger test problems.

3 Practical information and assessment

You will be working together in groups of 2–3 students. At the end of Friday, from 3pm, each group will present their work to the lecturers and other groups in 10–15 min oral presentations, and each group member is expected to contribute. There is no written report – assessment is solely based on the oral presentation. In the presentation please explain what you have chosen to investigate, which theory/tools you have used, show your results (plots, reconstructions, etc.) and state your conclusions.